THE ADVANCED SERVICES MODEL

Proposal for a Competitive and Efficient Universal Service High-Cost Approach for a Broadband World

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Executive Summary

CostQuest Associates submits this paper to supplement the record and to encourage the use of modern cost modeling for the advancement of efficient high-cost universal service funding that reflects the realities of today's broadband and mobile networks.

CostQuest Associates proposes the use of a modern modeling approach to determine the costs and, subsequently, the support for all carriers receiving high-cost universal service funding. Development of the model and its design criteria has begun. We invite other parties, from all sides of the debate, to join the effort and contribute to the model's design and completion. In this paper, we describe a path forward for creating a modern model, including basic design criteria and a critical issues list, a planned deployment approach, project scope and a timeline.

The FCC's current universal service system was established almost ten years ago. At the time, the FCC had just released the Synthesis model as a modern tool for calculating telecommunications costs for purposes of supporting universal service. However, the telecommunications landscape has changed dramatically and has left the funding mechanism outdated. With new technology, methodology, and data, we're poised to address these issues today.

Every current universal program relies on both a "cost model" and a "support model". A cost model produces an estimate of the cost of providing a telecommunications service. A support model produces a universal service support amount for the carrier or its customer based, in part, on the costs of service.

Currently, the cost model used for determining the costs of rural carriers is the NECA embedded book process and the cost model used for determining the costs of non-rural carriers is the FCC's Synthesis model. Both models develop the costs of the landline network.

The current support model is based on a cost benchmark approach. A support model could take many other forms, including reverse auctions, caps, and cost or revenue based benchmarks. However, each type of support model relies on the integrity of cost results from the cost model to provide a solution. Therefore, in order to make meaningful changes to the support model, it is critical to get the cost model right. Unfortunately, each of the cost models used in the current federal universal service system are outdated.

We propose that the ideal, modern cost model for use in a reformed universal service system is one that is designed to model forward-looking costs; all carrier types and all technologies would be modeled, and geographic granularity would be used.

The benefits of a properly developed forward looking economic cost model for universal service include:

- Clarification of concepts of the least-cost provider
- Normalization of participants

- Metrics and analytics to examine issues such as targeting, reserve levels for auctions, service definitional changes, etc..
- An avoidance of asymmetric embedded costs mechanisms
- A less onerous process for stakeholders and policy makers
- A clear link between defined service and costs developed
- Superior incentives to build broadband networks

CostQuest is committed to creating a modern cost model that can be used in today's universal service debate. In designing the modern cost model, we will address several design questions:

1. *What are the design criteria?*
   a. *What technologies are we modeling?*
   b. *What is the cost object?*
   c. *What are the regulatory criteria?*
   d. *What are the economic criteria?*
   e. *What are the modeling criteria?*
2. *Input Criteria:*
   a. *What is the source of service demand, material, labor rate, and engineering inputs?*
   b. *What is the source of operational expenses to capture uniqueness of landline versus wireless?*
   c. *What is the source and how much actual network (towers, exchange locations, boundaries) do we use?*
3. *Output Criteria:*
   a. *What is the geographic entity for calculation, comparing and reporting?*

As we move forward and get clarification on the path forward design criteria, we propose that the FCC engages CostQuest or other similar firms to start a first phase in which a conceptual design document will be created. This "proof of concept" phase can be completed within 5 months.

In the second phase, we propose that the FCC implement the proof of concept design, utilize test input data, and present the capabilities based on a demonstration in a number of actual service areas. This second phase could be completed 3 months after the first phase.

After review and input on the prototype model from interested parties, a national platform would then need to be implemented. We expect that this collaborative effort will include the FCC, the Joint Board, state commissions, and interested carriers. As such, the timeframe will naturally become extended. However, we would still expect that a completed platform could be rolled out in 2009.

Introduction

Today, we stand at a critical juncture in the evolution and development of the universal service funding system in the United States. Established nearly 10 years ago, the current federal system for funding universal service has grown to an annual total of over $7B dollars. This growth has translated into an end user contribution rate of well over 11%. This growth in both funding levels and the contribution rate has led to the recent Joint Board recommended decision to cap the fund to provide time to fix the universal service funding system so that an equitable, sufficient, and predictable system can be instituted[2].

This paper focuses on the economic modeling aspects of universal service. We discuss the evolution of models, the ability of modern models to better reflect reality, methods for using models to normalize cost measures for participants via a standardized approach, and the ability of models to help understand cost differentials between wire centers and within wire centers. And, finally, we discuss methods for modeling multiple technologies in order to provide superior information for policy makers.

We also make a commitment to develop and refine a superior cost model for land-line providers in rural areas and a wireless cost model for CETCs.

Brief History of current USF

The FCC's current universal service system was established almost 10 years ago. At the time, the FCC had just released the Synthesis model as a modern tool for calculating telecommunications costs for purposes of supporting universal service. The Synthesis model was intended to measure the cost of an efficient provider, whether classified as a rural or non-rural carrier. However, the telecommunications environment in the mid to late 1990's was one in which land-line demand was still growing, competition had not yet fully developed, the most common technology for delivering telecommunications service

[2] Section 254 of the Communications Act, as amended, 47 U.S.C. §254 (2006), authorizes the FCC, in consultation with a Federal-State Joint Board, to preserve and advance universal service, based on seven principles: (1) Quality and rates: Quality services should be available at just, reasonable, and affordable rates. (2) Access to advanced services: Access to advanced telecommunications and information services should be provided in all regions of the Nation. (3) Access in rural and high cost areas: Consumers in all regions of the Nation, including low-income consumers and those in rural, insular, and high cost areas, should have access to telecommunications and information services, including interexchange services and advanced telecommunications and information services, that are reasonably comparable to those services provided in urban areas and that are available at rates that are reasonably comparable to rates charged for similar services in urban areas. (4) Equitable and nondiscriminatory contributions: All providers of telecommunications services should make an equitable and nondiscriminatory contribution to the preservation and advancement of universal service. (5) Specific and predictable support mechanisms: There should be specific, predictable and sufficient Federal and State mechanisms to preserve and advance universal service. (6) Access to advanced telecommunications services for schools, health care, and libraries: Elementary and secondary schools and classrooms, health care providers, and libraries should have access to advanced telecommunications services as described in subsection (h). (7) Additional principles: Such other principles as the Joint Board and the Commission determine are necessary and appropriate for the protection of the public interest, convenience, and necessity and are consistent with this Act. 47 U.S.C. §254(b)(1)-(7).

was the landline network, and dial-up service was the standard method for providing data services and access the Internet[3].

As we all know, the telecommunications landscape has changed dramatically over the last 10 years. Wireless phones are a part of everyday life. High-speed Internet access is the norm. Entire cities are WiFi enabled. IP telephony is available and widely used. Carrier competition is well established and expanding in the marketplace. The availability of a UNE-platform from incumbent local exchange carriers ("ILECs") has come and gone. And, landline penetration has fallen dramatically. However, the universal service funding system has not been updated to keep up with this dramatically altered landscape.

The recent growth in the total size of the federal universal service fund is clearly not being caused by the introduction or use of forward-looking cost models. The FCC's Synthesis model, which was released in 1998, is only used to calculate support for the High Cost Loop component for non-rural carriers, which, as of 2006, only represents $357M of the $4B High Cost portion of the fund. In other words, a forward-looking economic model is being used to determine less than 9% of the total of the federal universal service fund. The remaining 91% of the fund is determined based on a combination of embedded books and NECA processes.

The continued use of embedded costs to determine universal service support in 2008 would have surprised many in the industry if asked in the late 1990s. At the same time it released its Synthesis model in 1998, the FCC also ordered that rural carriers would be transitioned to a forward looking mechanism within 5 years[4]. Those five years have come and gone, as we contemplate options for universal service funding nine years later, and eleven years after adoption of the Act. In 1998, the issues and concerns surrounding the FCC's Synthesis model were not focused on the principle of using forward looking costs to determine support, but rather on the methods of implementing the FCC's model for the purpose of determining universal service costs. At the time the Synthesis model was released, the Rural Task Force found numerous issues with the model and convinced the FCC to defer its use for determining universal service costs for rural carriers. These issues were not with regards to the appropriateness of the fundamental concept of forward-looking costs, but rather with the mechanics of creating estimates of such forward-looking economic costs. Unfortunately, no one addressed the issues of the mechanics of such estimation in the interim. However, we are poised to address those issues today.

Models in USF

Whether one is considering forward looking economic costs, reverse auctions, or NECA accounting methods, a model of some sort forms the necessary background for funding. Indeed, every current universal program actually relies upon both a "cost model" and a "support model".

[3] At the time the proxy models were being developed, parties to the modeling proceedings were arguing whether 14 or 28Kb dialup service defined advanced services.
[4] CC Docket No. 96-45 (FCC 97-157), issued on May 8, 1997.

- A “Cost Model” is a systematized collection of mathematical procedures that takes as inputs geographic and non-geographic data and that produces an estimate of the cost of providing a telecommunications service. As such, it provides a normalized measure so that policy choices, technologies, carriers and geographic areas can be compared on a fair and impartial basis. For example, a cost model will help address: the cost impact if broadband is included; the cost of various technologies including: landline, mobile wireless and fixed wireless; or, the impact if the take rate varies; etc.

- A “Support Model” is a mathematical procedure that takes cost data as an input, sets a standard for acceptable customer payment or affordability, applies a funding model (regulatory or carrier based), and finally produces a universal service support amount for the carrier or its customer.

Consider the current system; the cost model for determining the costs of rural carriers is the NECA embedded book process and the cost model for determining the costs of non-rural carriers is the FCC’s Synthesis model. These models estimate the costs of providing service to a geographic area. The support model then uses the cost model information, in combination with other information, to determine the appropriate support amounts. For the non-rural carriers, the support model: a) averages the costs across an entire state, b) compares the statewide average cost to the national average costs, c) determines which states require funding by examining those states whose average cost is greater than two standard deviations above the national average, and d) distributes the funding within a state by utilizing the wire center costs. For non-rural carriers, the support model: a) averages costs across a study area, b) compares the operating area costs to the national average costs, and c) determines funding in an area by measuring the difference between study area costs and national average costs. Both support models serve the same function: to apply a subjective, policy-based formula to a set of empirical cost data, developed by a cost model, resulting in a determination of the appropriate support amounts.[5]

By recognizing that these two types of models exist in the universal service system (one for empirical cost data and one for subjective policy decisions about support amounts) one can better focus on where issues exist and where decisions need to be made. Decisions will be made with regard to both types of models. But differences between the two types of models illicit different considerations. For instance, because the cost model produces empirical cost data, decisions will focus on the types of cost models used, inputs used, technologies modeled, and services delivered.. On the other hand, decisions made in the context of the support models will, by necessity, center on subjective policy decisions about averages, affordability, sustainability, competitive neutrality, universality, and other policy implications of a universal service system.

[5] While the support values may become measurable (e.g., 135% of the national average), the choice of the value itself has been largely subjective.

The current support model has created a fund that many believe is <u>un</u>sustainable. Changes to the support model will almost certainly occur, but these changes will be debated in terms of sufficiency, sustainability, explicitness, and their effects on competition, among other issues. Keep in mind that the support model can take many forms: (a) a cost-based benchmark that we utilize today; (b) a revenue-based benchmark that was proposed in response to the FCC's NPRM in the 10th Circuit remand proceeding; (c) reverse auctions; (d) caps, among many other forms.

Each of these types of support models relies on the integrity of cost data from the cost model to provide a solution. So, in order to make meaningful changes to the support model, it is critical to get the cost model right. Our focus here is on the cost models and their ability to provide the analytical data needed to examine policy choices that form the basis of a support model.

All of the cost models used in the current Federal USF system are outdated: 1) the FCC's land-line model has infirmities; 2) the embedded cost method (rather than forward-looking costs) sends inappropriate signals to market participants and provides inferior incentive mechanisms; 3) there is no existing forward-looking model, deployed here in the U.S., that accounts for the costs of providing mobile service domestically. Here we consider what is required to update the current cost model methodology and supporting changes to (or replacement of) the current cost models to insure more useful information in determining appropriate levels of universal service support.

Universal Service – What Should be Funded

The current system is convoluted at best (funds for price cap, rate of return, rural, and non-rural carriers, embedded costs and forward looking economic costs, etc.). The language of the Act should form the focus on principles. The Act states:

> "Consumers in all regions of the Nation, including low-income consumers and those in rural, insular, and high cost areas, should have access to telecommunications and information services, including interexchange services and advanced telecommunications and information services." This clause defines the need for access to telecommunications services and sets the foundation for a regulatory policy that ensures the U.S. will continue as the leader in telecommunication access, and, in turn, the economic leader of the world."

We believe universal service policy should focus on funding and providing access "pipes" of sufficient capability to all Americans. That is, there should be a single mechanism (collapse ICLS, IAS, HCM, HCL, LSS) that supports access in those areas of the country with higher cost access pipes (this would include the loop and transport and could exclude switching, signaling, E911, and other non-geographic driven network costs). These pipes can then be used to provide access to voice services alone (as the current fund provides) or access to broadband or IPTV, or other services, in the future.

Focus on the Cost Model

Given CostQuest's background, we feel uniquely qualified to provide advice on both cost model and support model issues. However, within this paper we focus on the cost model side of the universal service debate.

As we describe in the succeeding sections we encourage the FCC to create a unified support platform that supports access pipes provisioned from multiple technologies. The cost model used to provide information to create this support approach would include the following design parameters:

- Forward-looking,
- All carrier types would be modeled with toggles provided to differentiate the natural cost differences between size of carriers,
- Multiple technologies to provide at least wireline and wireless costs, and
- Geographic granularity to support multiple levels of geography that can be used to target high cost areas.

The 10 "Golden" Rules of USF Modeling

One of the most important guiding principles in the development of mechanisms for determining cost of service in recent telecommunications regulatory proceedings around the world has been the use of forward-looking cost studies. This holds true in proceedings relating to interconnection, unbundled network elements, and universal service. The U.S. has been an early proponent of forward-looking cost approaches. In fact, the FCC (with input from the Joint Board) made it quite clear in its Report and Order on Universal Service (in CC Docket No. 96-45 (FCC 97-157), issued on May 8, 1997, that forward-looking economic costs should be used to determine the cost of providing universal service in rural, insular, and high cost areas. In addition, the order provided ten criteria designed to guide the review and acceptability of any cost values provided in universal service funding proceedings. The criteria as provided in the Report and Order are listed here (emphasis added), and are as important today as they were 10 years ago:

> *"250. Criteria for Forward-Looking Economic Cost Determinations. Whether forward-looking economic cost is determined according to a state-conducted cost study or a Commission-determined methodology, we must prescribe certain criteria to ensure consistency in calculations of federal universal service support. Consistent with the eight criteria set out in the Joint Board recommendation, we agree* ***that all methodologies used to calculate the forward-looking economic cost of providing universal service in rural, insular, and high cost areas must meet the following criteria****:*

> (1) ***The technology assumed in the cost study or model must be the least-cost, most-efficient, and reasonable technology for providing the supported services that is currently being deployed.*** *A model, however, must include the ILECs' wire centers as the center of the loop network and the outside plant should terminate at ILECs' current wire centers.* ***The loop design incorporated into a forward-looking economic cost study or model should not impede the provision of advanced services****. For example, loading coils should not be used because they impede the provision of advanced services. We note that the use of loading coils is inconsistent with the Rural Utilities Services guidelines for network deployment by its borrowers.*

Wire center line counts should equal actual ILEC wire center line counts, and the study's or model's average loop length should reflect the incumbent carrier's actual average loop length.

(2) *Any network function or element, such as loop, switching, transport, or signaling, necessary to produce supported services must have an associated cost.*

(3) ***Only long-run forward-looking economic cost may be included****. The long-run period used must be a period long enough that all costs may be treated as variable and avoidable****. The costs must not be the embedded cost of the facilities, functions, or elements.*** *The study or model, however, must be based upon an examination of the current cost of purchasing facilities and equipment, such as switches and digital loop carriers (rather than list prices).*

(4) *The rate of return must be either the authorized federal rate of return on interstate services, currently 11.25 percent, or the state's prescribed rate of return for intrastate services. We conclude that the current federal rate of return is a reasonable rate of return by which to determine forward looking costs. We realize that, with the passage of the 1996 Act, the level of local service competition may increase, and that this competition might increase the ILECs' cost of capital. There are other factors, however, that may mitigate or offset any potential increase in the cost of capital associated with additional competition. For example, until facilities-based competition occurs, the impact of competition on the ILEC's risks associated with the supported services will be minimal because the ILEC's facilities will still be used by competitors using either resale or purchasing access to the ILEC's unbundled network elements. In addition, the cost of debt has decreased since we last set the authorized rate of return. The reduction in the cost of borrowing caused the Common Carrier Bureau to institute a preliminary inquiry as to whether the currently authorized federal rate of return is too high, given the current marketplace cost of equity and debt. We will re-evaluate the cost of capital as needed to ensure that it accurately reflects the market situation for carriers.*

(5) ***Economic lives and future net salvage percentages used in calculating depreciation expense must be within the FCC-authorized range****. We agree with those commenters that argue that currently authorized lives should be used because the assets used to provide universal service in rural, insular, and high cost areas are unlikely to face serious competitive threat in the near term. To the extent that competition in the local exchange market changes the economic lives of the plant required to provide universal service, we will re-evaluate our authorized depreciation schedules. We intend shortly to issue a notice of proposed rule making to further examine the Commission's depreciation rules.*

(6) *The cost study or model must estimate* ***the cost of providing service for all businesses and households within a geographic region****. This includes the provision of multi-line business services, special access, private lines, and multiple residential lines. Such inclusion of multi-line business services and multiple residential lines will permit the cost study or model to reflect the economies of scale associated with the provision of these services.*

(7) ***A reasonable allocation of joint and common costs*** *must be assigned to the cost of supported services. This allocation will ensure that the forward-looking economic cost does not include an unreasonable share of the joint and common costs for non-supported services.*

(8) *The cost study or model and all underlying data, formulae, computations, and software associated with the model must be available to all interested parties for review and comment.* ***All underlying data should be verifiable, engineering assumptions reasonable, and outputs plausible****.*

(9) ***The cost study or model must include the capability to examine and modify the critical assumptions and engineering principles.*** *These assumptions and principles include, but are not limited to, the cost of capital, depreciation rates, fill factors, input costs, overhead adjustments, retail costs, structure sharing percentages, fiber-copper cross-over points, and terrain factors.*

(10) *The cost study or model must deaverage support calculations to the wire center serving area level at least, and, if feasible, to even smaller areas such as a Census Block Group, Census Block, or grid cell.* ***We agree with the Joint Board's recommendation that support areas should be smaller than the carrier's service area in order to target efficiently universal service support****. Although we agree with the majority of the commenters that smaller support areas better target support, we are concerned that it becomes progressively more difficult to determine accurately where customers are located as the support areas grow smaller. As SBC notes, carriers currently keep records of the number of lines served at each wire center, but do not know which lines are associated with a particular CBG, CB, or grid cell. Carriers, however, would be required to provide verification of customer location when they request support funds from the administrator."*

Benefits of Forward Looking Economic Cost Models

Economic View

The importance of forward-looking costs for economic efficiency, business decisions, and sound public policy.

The determination of forward-looking costs forms the proper foundation for sound business decisions and sound public policy decisions and is necessary for determinations of economic efficiency.[6] The term "forward-looking" is not often used by economists, but it is implicit in fundamental economic cost concepts. The fundamental economic concept of opportunity cost clearly rests upon a forward-looking evaluation. Foregone opportunities are not foregone until a decision is made and an action is taken committing resources to one use rather than others. Forward-looking costs are the costs that properly reflect the value of resources that *will be* used up (or dedicated to an activity for some period of time) in the future because of a decision and a consequent action.[7]

Similarly, the fundamental nature of sunk costs reveals that costs are forward-looking; one should ignore past expenditures (book values) because they correspond to past events

[6]See, Nagle, Thomas T., *The Strategy & Tactics of Pricing: A Guide to Profitable Decision Making*, 14-28 (Prentice Hall 1987)(at page 15: "Only forward-looking costs are relevant for pricing because only they represent the true cost of doing business.")

[7] See, generally, Buchanan, J. M., *Cost and Choice: An Inquiry in Economic Theory*. University of Chicago Press, 1969; Buchanan, J. M. and Thirlby, G. F., eds., *L.S.E. Essays on Cost*. Weidenfeld and Nicholson, 1973 (reprinted New York, New York: University Press, 1981); Heyne, Paul, *The Economic Way of Thinking*, 2002 (10^{th} Edition), (Prentice Hall).

and are irrelevant in the valuation of current assets and current decisions.[8] The sunk cost economic dictum reminds one that the forward-looking valuation of resources does not necessarily match historical purchase values or the remaining un-depreciated value on the books of account. Anyone not heeding the sunk cost dictum will perform poorly when selling real estate (historical costs will understate current values), and used computers (historical costs will overstate current values).

The economic distortions caused by regulation based on historical costs

Historically, virtually all local exchange companies in the United States were regulated as rate-base, rate-of-return (RoR) monopolies.[9] The opinion in the famous Hope Natural Gas case established the legal precedent that RoR regulation of utilities would be on the basis of the historical investment of the companies, rather than on the forward-looking market value of investments.[10]

However, economists and regulators alike have for many years expressed concerns that the incentives created under RoR regulation reduce economic efficiency.[11] In the early 1960s, economists described the potential for RoR regulation to distort input choices, i.e., to lead to inefficiency in production, and the potential to lead to inefficiency in exchange and dynamic inefficiency as well.[12] RoR regulation may also lead to higher regulatory costs, higher costs of regulatory compliance; and significant costs of collecting and auditing cost information. RoR regulation retards incentives to innovate (since superior products and services do not lead to superior earnings) with losses in dynamic efficiency. Perhaps most importantly, RoR regulation reduces a firm's incentives to minimize costs since cost reductions lead not to sustained increases in earnings, but rather to reductions in prices. Conversely, increases in costs lead to price adjustments sufficient to create corresponding increases in revenues.

The disadvantages of RoR regulation were outlined in a report by the NTIA in 1987. Later that same year the FCC issued a NPRM on price caps in CC Docket 87-313. In the early 1990s RoR regulation was replaced with price cap regulation for AT&T and the large ILECs. During the late 1980s and 1990s, most state public utility commissions also abandoned RoR regulation for a form of incentive regulation. By the end of 2000, all but seven states had adopted some form of incentive regulation for large ILECs.[13]

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[8] See virtually any principles of economics textbook or any textbook on microeconomic theory.
[9] See generally, Kahn, Alfred, *The Economics of Regulation: Principles and Institutions, Volume I,* 1970; and Phillips, Charles F., *The Economics of Regulation*, 1965.
[10] *Federal Power Commission v. Hope Natural Gas Co.,* 320 U.S. 591, 601 (1944).
[11] See e.g., Incentive Regulation for Public Utilities (M. A. Crew ed.) 1994; Price Caps and Incentive Regulation in Telecommunications (M. A. Einhorn ed.) 1991.
[12] See Averch, Havery A., and Leland Johnson, "Behavior of the Firm Under Regulatory Constraint, *American Economic Review*, 52, 1962; and Spann, Robert M**.,** "Rate of Return Regulation and Efficiency in Production: An Empirical Test of the Averch-Johnson Thesis." *Bell Journal of Economics and Management Science,* 5, 1974, pp. 38-52.

[13] Telecom A.M., November 1, 2000, Vol. 6, Issue 209.

The Telecommunications Act of 1996 rejects RoR-based methods for pricing for interconnection and UNEs by noting that they be "determined without reference to a rate-of-return or other rate-based proceeding."[14] §51.505 of the FCC's UNE rules establishes the cost method for states to employ when pricing UNEs using "the forward-looking cost over the long run," forward-looking cost of capital, forward-looking common costs, and which precludes consideration of "embedded costs."[15] The Supreme Court upheld the use of forward-looking costs be the FCC[16] Indeed, at footnote 17 the Supreme Court cites some of the relevant economics literature:

> Nor is it possible to argue that "cost" would have to mean past incurred cost if the technical context were economics. See D. Carlton & J. Perloff, Modern Industrial Organization 50—74 (2d ed. 1994) (hereinafter Carlton & Perloff). "Sunk costs" are unrecoverable past costs; practically every other sort of economic "cost" is forward looking, or can be either historical or forward looking. "Opportunity cost," for example, is "the value of the best forgone alternative use of the resources employed," *id.*, at 56, and as such is always forward looking. See Sidak & Spulber, Tragedy of the Telecommons: Government Pricing of Unbundled Network Elements Under the Telecommunications Act of 1996, 97 Colum. L. Rev. 1081, 1093 (1997) (hereinafter Sidak & Spulber, Telecommons) ("Opportunity costs are … by definition forward-looking").

In addition, the FCC (with input from the Joint Board) made it quite clear in its First Report and Order on Universal Service, that forward-looking economic costs should be used to determine the cost of providing universal service in rural, insular, and high cost areas.[17] In addition, as noted above, the order provided ten "Criteria for Forward-Looking Cost Determinations."[18]

However, small ILECs in the United States continue to be regulated under full-cost recovery RoR mechanisms. And given the relatively small size of many of these companies, and the significant costs of monitoring RoR companies and engaging in RoR reviews, state rate cases are seldom performed. Retail prices for many firms have not

[14] TA96, Section 251 (d).

[15] *In re* Implementation of the Local Competition Provisions in the Telecommunications Act of 1996 (CC Docket No. 96-98) (released Aug. 8, 1996); Appendix B, Final Rules. Title 47, Code of Federal Regulations.

[16] Supreme Court of the United States, Nos. Nos. 00-511, 00-555, 00-587, 00-590, and 00–602 (Verizon Communications Inc. V. FCC 535 U.S. 467 (2002) 219 F.3d 744, affirmed in part, reversed in part, and remanded). **"**The issues are whether the FCC is authorized (1) to require state utility commissions to set the rates charged by the incumbents for leased elements on a forward-looking basis untied to the incumbents' investment, …" (para 1); and "Whether the FCC picked the best way to set these rates is the stuff of debate for economists and regulators versed in the technology of telecommunications and microeconomic pricing theory. The job of judges is to ask whether the Commission made choices reasonably within the pale of statutory possibility in deciding what and how items must be leased and the way to set rates for leasing them. The FCC's pricing and additional combination rules survive that scrutiny." (page 68,).

[17] CC Docket No. 96-45 (FCC 97-157), issued on May 8, 1997.

[18] Id, at paragraph 250. See James W. Stegeman "Proposal for a Competitive and Efficient Universal Service High Cost Funding Model/Platform" Attachment I to Comments of Western Wireless CC Docket No. 96-45, filed May 5, 2003, for a listing of the criteria and a more detailed discussion of issues related to the estimation of forward-looking costs.

changed in years, and in many instances decades. More importantly for the purposes of this proceeding, high-cost universal service reimbursement for small ILECs continues to be based on historical investments and historical costs.

Therefore, the current system based of historical cost recovery leads to the well-known incentives for these firms to behave inefficiently. As modifications to the universal service reimbursement mechanism in the United States are considered, it is critical for the FCC to help break the link to RoR regulation-type processes.

It is now well over twelve years after the passage of the Telecommunications Act of 1996, and eleven years since the FCC's TELRIC rules were published. Moreover, it is two decades since the FCC's finding that RoR mechanisms provide inferior incentives to market participants.

Given this record, and the availability of next generation costing models, the time is ripe for the FCC to move to a forward-looking cost standard for all universal service funding (not just for large ILECs). While the HCPM may have short comings, reasonable forward-looking cost estimates can be produced for rural areas using latest generation network models. In the long run, this will be less effort and more productive than manipulating a support model based on historical cost data.

Clarification of concepts of the least-cost provider

In its First Report and Order on local competition, the FCC advanced a standard for UNE pricing based on the costs of the most-efficient, least-cost provider.[19] Similarly, in its First Report and Order on Universal Service, the Commission stated in it's forward-looking cost principle number one: "[t]he technology assumed in the cost study or model must be the least-cost, most-efficient, and reasonable technology for providing the supported services that is currently being deployed."[20]

However, it is critical to note that forward-looking cost concepts should not imply a standard that is unattainable by real firms.[21] Efficiency can actually be reduced by employing a least-cost standard that is not attainable by firms operating in real markets.[22]

[19] Federal Communications Commission (FCC), *Re-Implementation of the Local Competition Provisions of the Telecommunications Act of 1996.* Appendix B. (Final Rules, Amendments to the Code of Federal Regulations) 47 C.F.R., 1996, § 51.505.
[20] CC Docket No. 96-45 (FCC 97-157), issued May 8, 1997, paragraph 250.
[21] See e.g., Massa, Salvatore, Mark E. Meitzen, and Steve G. Parsons, "Pricing Network Elements Under the Telecommunications Act of 1996: Back to the Future" *Hastings Communications and Entertainment Law Journal*, Vol. 23, number 4 (2001); Parsons, Steve G, "Laffont and Tirole's Competition in Telecommunications: A View From the U.S." 9 *International Journal of the Economics of Business*, 2002 (pp. 419-436).
William E. Taylor, "Efficient Pricing of Telecommunications Services: The State of Debate," 8 *Journal of Industrial Organization*, 25, 31 (1993); and Weisman, Dennis, "The (In)Efficiency of the 'Efficient-Firm' Cost Standard," *Antitrust Bulletin*, 1998.
[22] Cost calculations that are too low lead to reimbursement that is too low, leading to improper signals to invest, and reduced incentives to deploy technology or develop new technology.

Indeed, the concept of forward-looking costs does not rest upon a least-cost standard; forward-looking cost concepts are far more general.

When a firm is already regulated under incentive regulation, least-cost concepts are less important for encouraging efficient behavior. For those ILECs already under incentive regulation mechanisms, there is less to be gained by attempting to create additional incentive mechanisms under UNE pricing or universal service standards; the firm already has an incentive to be efficient (to the extent allowed in the provision of services with a real network). However, forward-looking cost based mechanisms send superior market signals to all market participants.[23]

The unfortunate circumstance in U.S. telecommunications today is that the small carriers that are predominantly RoR regulated in intrastate jurisdictions also rely on embedded costs to determine funding from switched access charges and universal service. Therefore these companies have completely missed the efficiency improving mechanisms of forward-looking costs and incentive regulation that exist for large companies (facing both incentive regulation and forward-looking cost standards for UNEs and universal service).

Moreover, a stronger case can be made for a standardized forward-looking cost mechanism for universal service funding than for UNE pricing. With UNE pricing, elements are provided by one specific firm via that firm's assets, and the costs should be specific to that firm. However, universal service funding is not specific to a firm. Universal service funding is portable to any firm that is qualified. Moreover, should reverse auctions be employed for determining and distributing universal service funding, the auction result will reflect competition between firms, and potentially between technology types. Modern concepts of universal service funding should properly be competitively neutral and forward looking.

Normalization of Participants

The use of a forward-looking, computer based model allows policy makers to examine potential support approaches with what economist like to refer to as an "all else equal" approach. That is, they examine how terrain, density, service area demographics, and other objective factors impact costs; the detail of the model allows one to hold "all else equal. The same cannot be said of the use of embedded books. How can one understand the impact of including or excluding broadband from the embedded books? How can one understand the impact of funding at an independent geographic level such as a Census Block from the embedded books? How can one examine the cost of an efficient network deployment from the embedded books? The answer to all of these is – "it would be very difficult, would rely on significant volumes of carrier data that may not be readily available, and would require the use of numerous manipulations and assumptions."

[23] For example, if performed correctly (without assuming unachievable levels of network efficiency and optimization) forward-looking cost based UNEs send appropriate "lease or build" incentives.

Metrics and Analytics to Examine

A properly constructed forward-looking economic cost (FLEC) model can provide assistance for support model choices, such as:

- The cost in a Cost Based Benchmark Support model;
- The cost in a Rate based Benchmark Support model;
- Identification of high cost areas for targeting purposes;
- Evaluation of success and acceptance of bids (reserve level) in a reverse auction Support Model;
- What ifs and Pilots; and,
- Creation of effective Caps (instead of an arbitrary number).

In addition to these key support model metrics, FLEC models can help understand

- Technology choices,
- Engineering choices (copper distance, bandwidth changes, etc..),
- Geographic choices (even down to the customer),
- Service choices,
- Customer choices,
- Etc..

Avoid Asymmetric Embedded Cost Mechanisms

Under the current system, rural incumbents receive funding based on full embedded costs, regardless of the incumbent penetration rate. As incumbent penetration declines, funding per line rises. This funding mechanism is asymmetric (no such "make whole" opportunities exist for CETCs) and creates perverse incentives for all participants. This system is counter to the fundamental goals of the Act and counter to the workings of competitive markets in general.

Less onerous on stakeholders, policy makers

While the development and population of a forward-looking economic cost model is initially time consuming, in the long run, it reduces the burden on policy makers and stakeholders. An embedded book based system requires standard books, broad assumptions, post-hoc modifications, public filings of sensitive data, and all at a fairly high geographic level (e.g., study area). If this is imposed on all parties, including wireless carriers, the effort would be sizeable. With the adoption of a FLEC model, there is no need for forced accounting structure, forced reporting, or other mechanisms, while providing the added bonus of geographic granularity for targeting and multiple paths for sensitivity analysis.

Clear link between defined service and costs developed

If it is decided that a simple Access Pipe should be funded (no service-specific electronics for voice, broadband, or IPTV), a model can be developed to evaluate and quantify these costs. If broadband deployment is authorized as a covered component, at some point in time, the model can then simply provision the electronics for the specific service over the simple Access Pipe. Such a model can be used to evaluate the impact of including broadband, and other scenarios.

Economic models provide superior incentives

As noted above, FLEC provides superior incentives consistent with competitive markets. Such models enjoy the following advantages:

- Forward-looking costs are those relevant to sound business decisions and sound public policy;
- FLEC-based mechanisms are competitively-neutral (both with respect to technology and ownership of assets) mechanisms do not distort market outcomes;
- They do not reward inefficiency; and.
- They endorse consumer sovereignty (consumers, not regulators, choose among providers and technologies).

Caveats

While forward-looking cost models can be designed to accurately reflect the costs of providing service, they are at the mercy of reliable input data, active maintenance, and regular upkeep. As such, the cost model is only as good as the data used to run the model and the ability of the algorithms to reflect the current state of the telecommunications environment. Therefore, it is vital that cost models receive periodic maintenance.

The upfront input and regular maintenance of the cost model should cover design, regulatory, economic and engineering criteria. It is of paramount importance that careful attention is paid to the following areas of data input and maintenance:

- Operational costs
- Demand data
- Attribution or allocation methods for indirect capital expenses
- Network material prices, capacities and constraints
- Internal labor rates
- External contractor rates
- Depreciation lives
- Financial data (e.g., asset lives and cost of money)
- Engineering design parameters
- Technologies used
- Algorithms

It's equally important to properly establish the model framework and the design criteria. Below are the crucial decisions related to the model and its output.

- Will the most efficient provider be modeled or will the model consider all providers in an area?
- What is the source for demand data (customers) and the geographic extent?
- What is the source for existing coverage areas?
- What is the extent of data to be supplied by carriers?
- How to define or include the service attribute of mobility?
- How to define full coverage?

- How do we reflect or take into account regulatory obligations such as COLR, 911/E911, affordability, etc.?

Global use of Forward Looking Cost Models

Forward looking long-run incremental costs are used across the globe for wireline interconnection pricing, universal service issues, retail pricing, and pricing of unbundled network elements.

Over the last decade, the forward-looking cost methods, so common for wireline services, have begun to be adopted for wireless technologies as well. Today, the use of wireless LRIC models is also commonplace in other countries. For several years now, regulatory commissions around the world have employed cost models to model wireless costs in a variety of regulatory settings and for a variety of purposes. In New Zealand, for instance, the Commerce Commission has, for several years, used wireless cost modeling in its Telecommunications Service Obligation proceeding, that country's version of universal service. The New Zealand commission employs a wireless cost model to determine the cost of providing service in rural and remote areas where the provision of wireline service is inefficient[24].

In Australia, the Competition and Consumer Commission initiated a proceeding in which it is considering the adoption of a wireless cost model to be used to set mobile terminating access pricing[25].

In Hungary, the national commission (NHH) adopted the use of a wireless cost model in order to establish mobile price controls.[26]

In March of 2007, the Danish telecommunications regulatory body, NITA, initiated a study, to be performed by Analysys Consulting, to develop a long-run average

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[24] *See Final Determination for TSO Instrument for Local Residential Service for period between 1 July 2003 and 30 June 2004*, New Zealand Commerce Commission (adopted March 23, 2007), pp. 48-49, ¶¶ 214-222 & Appendices 2, 3, and 9 (found at http://www.comcom.govt.nz//IndustryRegulation/Telecommunications/TelecommunicationsServiceObligations/ContentFiles/Documents/TSO_LRS_final_public_03_04.pdf)

[25] *See Discussion Paper on the WIK Mobile Network and Cost Model to inform the MTAS Pricing Principles Determination 1 July 2007 to 30 June 2009*, Australian Competition and Consumer Commission (February 2007) (found at http://www.accc.gov.au/content/item.phtml?itemId=785320&nodeId=a56f1e88b6d2853a8219d7972aa9b83c&fn=Discussion%20Paper%20on%20WIK%20mobile%20network%20and%20cost%20model%20(Feb%2007).pdf). *See also Mobile Termination Cost Model for Australia, Report for the Australian Competition and Consumer Commission*, by wik-Consult, Brinkmann, Hackbarth, Ilic, Neu, Neumann, Figueras, & Honnef (January 2007) (found at http://www.accc.gov.au/content/item.phtml?itemId=784498&nodeId=1a2eee9394ef3123590dbf874692a13b&fn=14.%20WIK%20Report.pdf)

[26] *See Letter from Fabio Colasanti,Director General, European Commission to Mr. Marcell Horváth, Nemzeti Hírközlési Hatóság, re: Case HU/2006/0478: Voice call termination on individual mobile networks in Hungary; Article 7(3) of Directive 2002/21/EC1* (September 22, 2006) (found at http://circa.europa.eu/Public/irc/infso/ecctf/library?l=/hungary/registered_notifications/hu20060478/decision_pubpdf/_EN_1.0_&a=d)

incremental cost model for mobile termination. The study will take 14 months and will consider the costs of both 2G and 3G networks.[27]

While the above is not an exhaustive list, we are also aware that the following countries have also adopted "LRIC" for use in mobile termination rate-setting: United Kingdom, Sweden, Norway, The Netherlands, Greece, Belgium, France, Botswana, Tanzania, Malaysia, and Israel. We are also aware that LRIC models will soon be implemented in Denmark and Germany, and that Mobile LRIC studies have been performed in other countries.[28]

Prior issues with FLEC Models

In 1998, the FCC released the much anticipated Synthesis Model for determining universal service funding in the U.S. From its inception, the FCC's Synthesis Model was intended to be used to identify costs in the development of support amounts for non-rural carriers. One critical issue—whether the platform would be applicable to rural carriers (although not necessarily rural areas)—was left open for further discussion and determination.

Ten years later, we have the retrospective advantage of a track record of dealing with issues related to the use of the Synthesis Model. It is useful to consider a number of the issues relating to the Synthesis Model from the two different perspectives of rural carriers and non-rural carriers.

The Synthesis Model has been used to derive universal service funding for non-rural carriers at both the federal and, in some cases, the state level. However, this has not been without controversy. In the various proceedings, the following issues have been raised and heavily debated, in addition to many others:

- The use of Statewide averages to determine which carriers are to receive funding
- The use of a cost benchmark with a 135% break point
- The lack of updated customer location data
- The lack of specificity in the special access demand in the model
- The line demand to use in the model with competition grabbing an increasing share of the local market
- The lack of recognition, in the customer dataset, of:
    - Multi-tenant structures
    - Second lines
    - High cap lines
    - Lots
- Potential for overbuilding the distribution loop plant
- Inadequacy of the HAI vendor switching inputs
- Lack of updates to the cost inputs

[27] See Company Announcement, Analysys Consulting (April 2007) (found at http://www.analysys.com/default.asp?&m=7137&n=%25name-id%25&Mode=article&iLeftArticle=1564)
[28] Based on work by the authors and correspondence with other cost analysts around the world. We do not mean to imply that a forward-looking LRIC is the only model of method examined in each of these countries,

- Lack of access to the customer dataset
- Use of rectilinear distances to cluster and route, which do not follow roads or observe any natural hindrances to routing
- Use of pair equivalents to build all components of the network and to allocate the cost of all components out to services (including fiber and electronics)
- Poor quality of exchange boundaries
- Use of V&H coordinates to locate central office switches

Clearly, a detailed discussion of these items alone could fill the pages of an extensive paper in its own right. They are identified here, however, only to indicate that the current Synthesis Model can be improved. Indeed, many of the platform and technical issues have been addressed with the new generation of models. Other issues can be addressed with updated data sets. Finally, some issues are more related to the Support model.

Regarding rural cost estimates, the Rural Task Force evaluated the Synthesis Model on the basis of the FCC's own 10 criteria, as well as additional criteria listed in Appendix D of the Rural Task Force's White Paper #4[29]. Using these criteria, the Rural Task Force found major issues with the FCC's Synthesis Model and recommended that it not be used. In summary, their concerns with the FCC's platform are as follows:

- Modeled lines differed significantly from actual lines
- Modeled route miles varied significantly from actual route miles
- Modeled investments differed from embedded investments
- Wire center areas and boundaries in the model did not match up to actuals
- The model underestimated switching investment
- Modeled general support investment varied significantly compared to actual
- The model underestimated actual network operations costs
- The use of a statewide average cost was inappropriate

Given the Rural Task Force's concerns regarding the use of the Synthesis Model to determine support for rural carriers, it recommended that an embedded cost determination should instead be used, on an interim basis, to set the funding levels. The FCC agreed and subsequently ordered a 5 year plan that is largely an implementation of the universal service funding platform based on the embedded costs of the rural carriers. Today, this system conflicts with the preponderance of regulatory decisions (both domestically and internationally), all of which recommend the use of forward looking costs instead.

Do the Rural Task Force Issues Still Exist?

All of the issues addressed by the Rural Task Force can be addressed by updated models and/or inputs. In consideration of the concerns raised by the Rural Task Force, we have examined the issues with respect to what can be done today.

- Modeled lines differed significantly from actual lines

[29] The White Paper can be found at http://www.wutc.wa.gov/rtf/old/RTFPub_Backup20051020.nsf/?OpenDatabase

ADDRESSABLE: This is an input issue that can be addressed by carriers participating in the process and providing actual company line data.

- Modeled route miles varied significantly from actual route miles
  ADDRESSABLE: This is a modeling issue that can be addressed using the latest generation of network cost models that create networks that follow the road with the use of Minimum Spanning Road Tree methodology.
- Modeled plant installed did not line up with actuals
  ADDRESSABLE: This is a modeling issue that can be partially addressed using the latest generation network cost models that create networks that follow the roads. However, it should be noted that Forward Looking Economic Cost models may properly vary from the books. New technology drives the value of all related technologies (in telecommunications, and every other industry). Forward-looking cost methods contribute to the rational management of universal service funding.
- Wire center areas and boundaries in the model did not match up to actuals
  ADDRESSABLE: This is an input issue that can be addressed by carriers participating in the process and providing actual company data. USAC has obtained, via requests for updated disaggregation plans, more accurate boundary data over the past two years for some carriers.[30] In addition, the private vendor data that was used for this in the past has improved over time.
- The model underestimated switching investment
  ADDRESSABLE: This is an input issue that can be addressed by carriers participating in the process and providing actual company data. However, with the advent of VoIP and the deployment of fiber, the cost of switching in a rural area is not necessarily a function of geography and carrier status. As such, since switching is less of an issue in defining an area high cost, we can focus on the concept of the Access Pipe (the connection of the customer back to a carrier's location, along with the transport to connect up the carrier's location) and those costs which are geographically driven,.
- Modeled General Support investment varied significantly compared to actual
  ADDRESSABLE: This is an input issue that can be addressed by carriers participating in the process and providing actual company data. However, it should be noted that universal service reflects the cost of an efficient carrier. As such, the cost may vary compared to actual.
- Model underestimated Network Operations costs
  ADDRESSABLE: This is an input issue that can be addressed by carriers participating in the process and providing actual company data. However, it should be noted that universal service reflects the cost of an efficient carrier. As such, the cost may vary compared to actual.
- The use of a Statewide Average cost was inappropriate

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[30]*See* http://www.usac.org/hc/about/understanding-disaggregation.aspx
"Implementation of Disaggregation Plans
The adoption of the disaggregation rules by the FCC required a large-scale effort by USAC to review and extract zone information and pricing data from ILEC disaggregation plans. In order to make this information available to ETCs, USAC posted all maps and disaggregation path selections to its website and provided all disaggregation plans to competitors via electronic mail, hard copy, and opportunities to view at USAC facilities."

> *ADDRESSABLE: This is a Support model issue that is intertwined with the jurisdictional control between state commissions and the FCC. If indeed the federal fund is intended to support entire high cost states, it is up to the state to provide for the explicit funding for high cost areas within the state. That is, statewide cost averaging continues the existing policy of focusing interstate funding on differences in costs between states; implicit cross-subsidies that may exist within states currently are the responsibility of the states in which such intra-state disparities exist. As such, it is not (nor should it be) solely the Commission's responsibility to fund high-cost areas within low-cost states.*

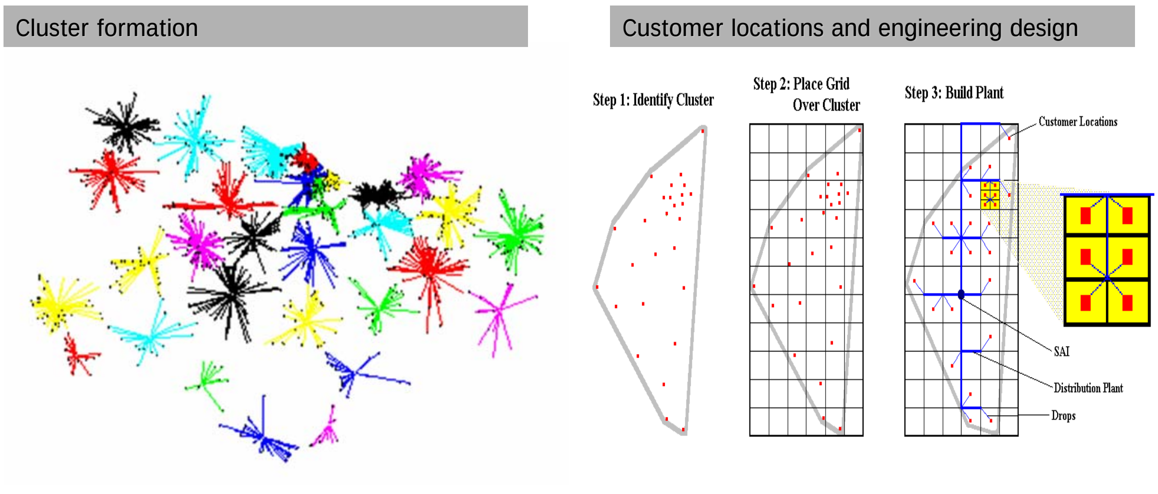
Advances in network cost modeling (for all types of networks)

The key about today's network costing models is that they can provide advancements that:

- Improve customer locations,
- Improve the ability to match engineering designs and constraints,
- Improve network routing,
- Improve the ability to vary the network design,
- Provide the ability to capture costs at various geographic levels, and
- Provide the ability to model multiple terrestrial networks.

Today a modern model can provide a more realistic, flexible network design resulting in more accurate cost estimates and improved information for decision makers.

To understand the improvement, it is best to view the processes of the current FCC, USF model as compared to what is feasible with a latest generation model.



Material courtesy of William Sharkey (FCC)

Figure 1

In Figure 1, we see the cluster formation and distribution design of the FCC's model. Looking at the image on the left, the clusters or grouping of customers are formed without utilizing road or actual routing and are based upon census data that has been randomly placed within the Census block. On the left side, the engineering cluster that is formed is overlaid with a uniform grid with rectilinear cable routing laid out in a nice, uniform, stylized format. In laying out the network, no road or actual routing is used.

Figure 2

In Figure 2, we see the approach used the latest models, including our CostPro model. The models first start with customer locations[31] geocoded along the road network. Geocoding simply refers to placing the customer's address at a point on the earth's surface.

With the customer points and the road network, we move to the next step: creating the network. As you look at this collection of road and customer data in Figure 2, you can almost start to visualize how the network will be deployed. Like what we all did in grade school, we connect the dots. The model algorithms have just added a bit engineering logic and optimization routines to how best to connect the dots along the roads.

[31] Ideally, carrier specific data should be used. However, if there are concerns about the proprietary nature of the data, CostQuest can provide public sourced estimated customer data. This can come from Census data or public vendors such as GeoResults.

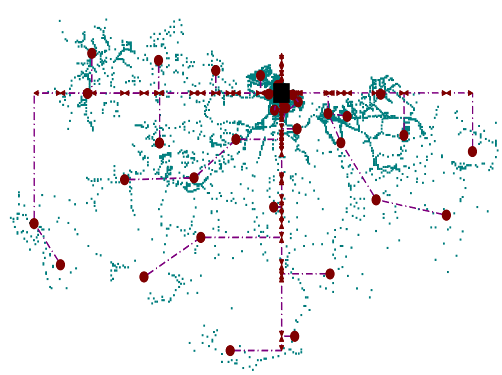
Figure 3

In Figure 3, the designed clusters and corresponding Network Node locations based upon CostPro are shown. The clusters and plant locations are optimally selected based upon user inputs, general network design principles, and actual road routing.

Once the model has the customers aggregated into clusters, the logic then begins the process of laying out the cabling network and the plant locations.

Rectilinear Distribution Design

Rectilinear Feeder Design



Material courtesy of William Sharkey (FCC)

Figure 4

In Figure 4, we return to the FCC's model. It reflects uniform, stylized distribution design on the left and the feeder design on the right. For distribution, the uniform rectilinear routing looks somewhat like the runways at an airport with a main east west route and a main North South route. For feeder plant on the right, the main feeder routes emanate along the compass rose with sub-feeder paths breaking off at right angles. In both pictures, no road or actual routing is used.

Road based design of wire center on prior figure

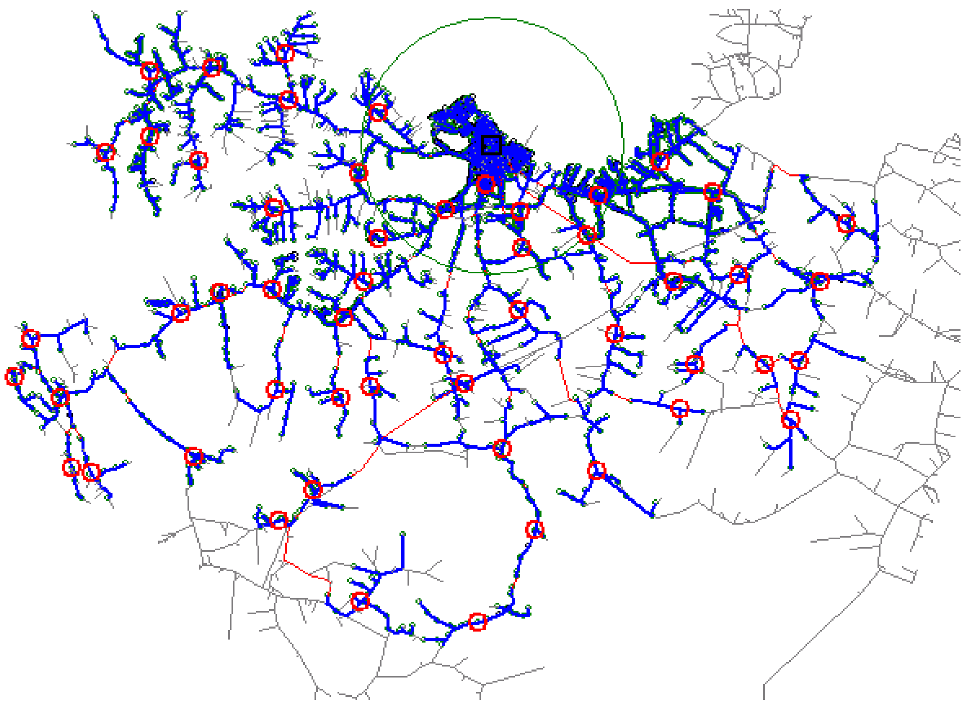


Figure 5

Figure 5 illustrates the road-based designs used in the latest models. For comparative purposes this chart shows the road routing applied to the same FCC datasets shown in prior figures. It is striking that it does not look anything like the stylized, uniform designs of the FCC's implemented model.

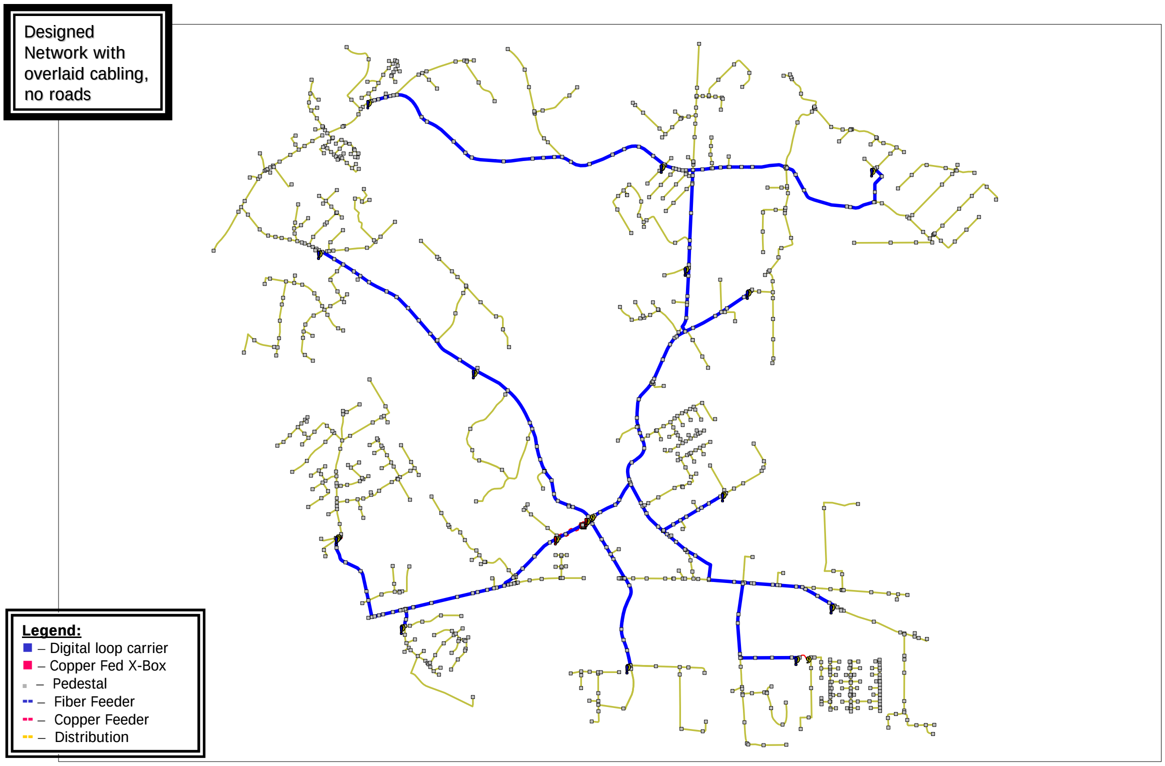


Figure 6

In Figure 6, the optimized Minimum Spanning Road tree ("MSRT") based network design of the latest generations models, such as CostPro, is shown. The blue on the chart shows fiber feeder, the red shows copper feeder, and the yellow captures the copper distribution. Here it is clear that the MSRT approach captures how a realistic network is designed.

Figure 7

Figure 7 shows the broadband capable network that can be designed within the current FCC model. From the blank screen, one might suspect that there was simply an error of omission on our part; but the blank screen reflects the fact that the current FCC model is only capable of developing a mid 1990 designed network capable of voice service, not broadband[32].

[32] At the time of the FCC model development, access to advanced services meant access to a 28.8 modem speed dial up internet service. How the environment has changed over the last 10 years.

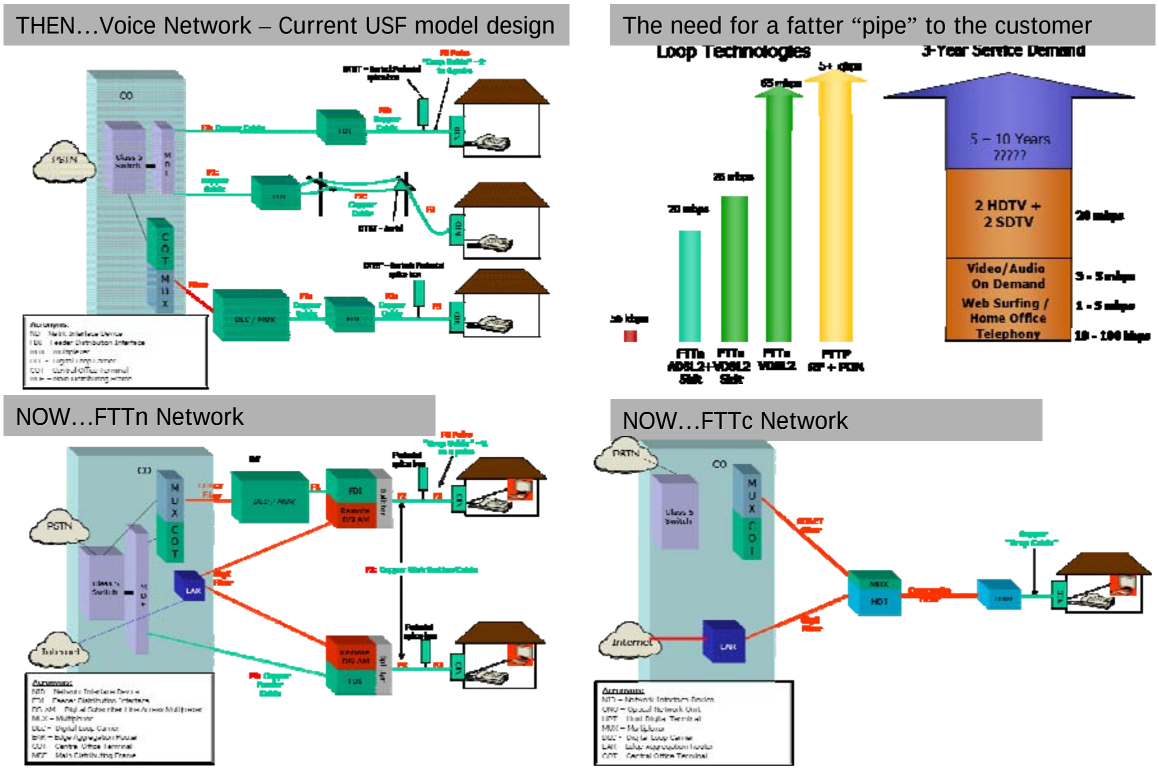


Figure 8

Figure 8 displays the network schematics of the historical voice network, and the latest generation fiber-based networks. Included in the figure is a demonstration of the bandwidth requirements and how the various network designs can meet these demands. Without expanding on the details, suffice it to say, the network deployments of today are different than what is designed in the FCC’s model.

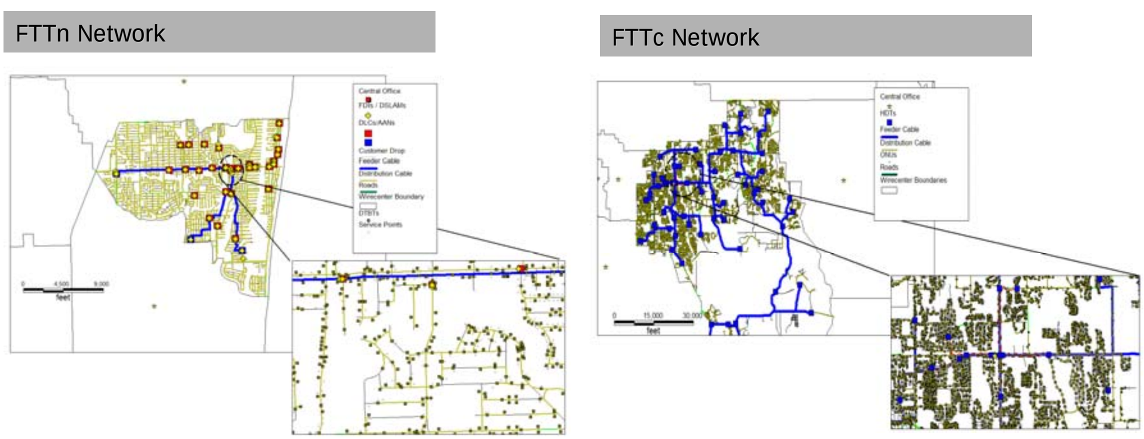


Figure 9

In Figure 9, the FTTn and FTTc road based designs available in CostPro are shown. The key logic driver for these networks, beyond road routing, is termination point of fiber in the network.

Another development that has occurred since the historical models were released is the explosion of wireless, both mobile and fixed.

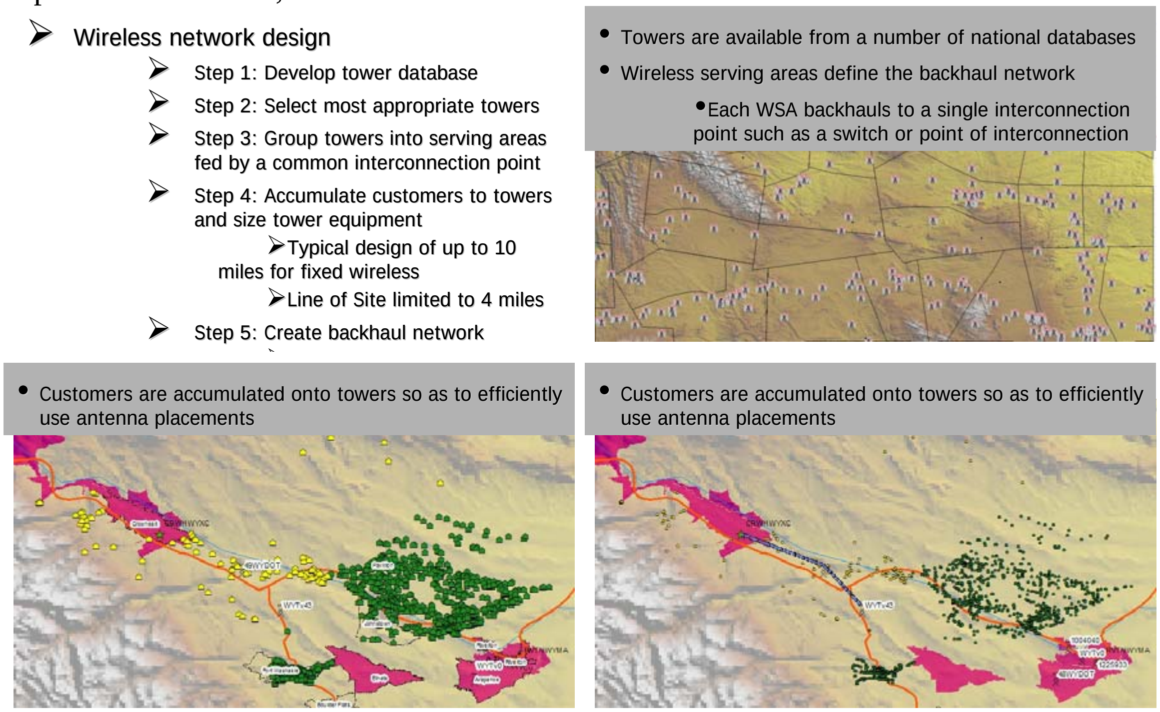


Figure 10

Figure 10 illustrates the general steps used to capture wireless costs within the CostPro platform. In some respects the modeling is easier, in others more difficult. Wireless models have the advantage of being able to ignore the road network in the first phase of modeling. However, wireless models have to capture RF propagation and/or viewsheds to determine what locations and areas can be served by a tower. Once the customers are associated with towers, the towers can be connected, via road information and MSRT methodology, back to the wireless carrier's POP (Point of Presence).

Consider now the ability to examine cost differentiation between and within wire centers. That is, the ability to determine where high cost areas are so that a funding model could be created to **target** funding more accurately.

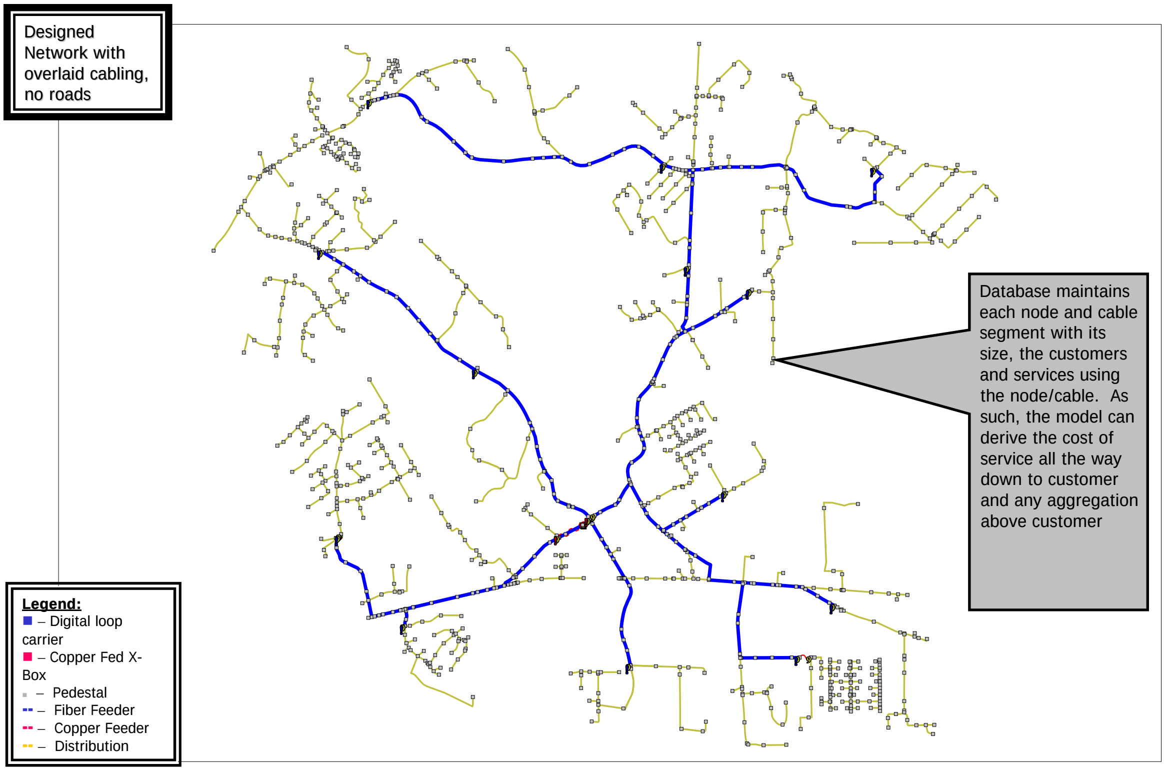


Figure 11

Figure 11 shows the network design of the CostPro model that was displayed earlier. In addition to the visual detail, the model maintains each node and cable segment along with customer locations and services using the node and/or cable segment. As such, the model can derive the cost of service all the way down to the customer and any aggregation above.

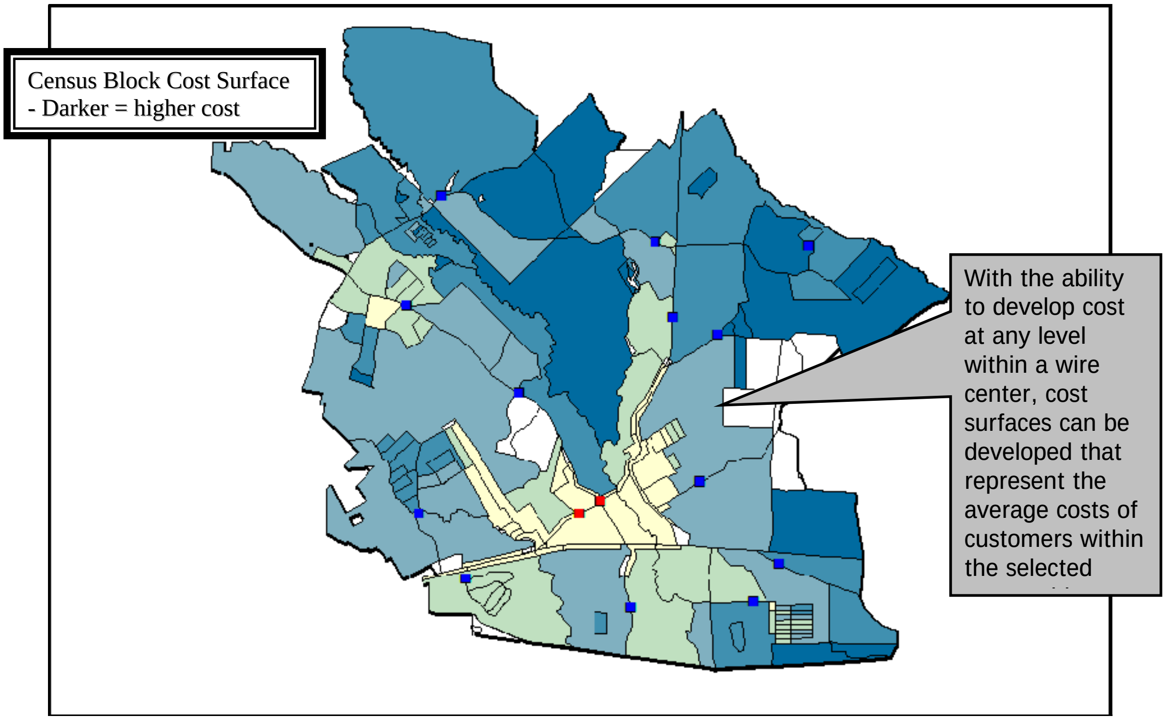


Figure 12

In Figure 12, cost has been simply averaged for each Census Blocks. As one would expect, the costs are lower (shown as a lighter color) closer to the central office and rise (shown as a darker color) farther from the central office in more sparsely populated areas.

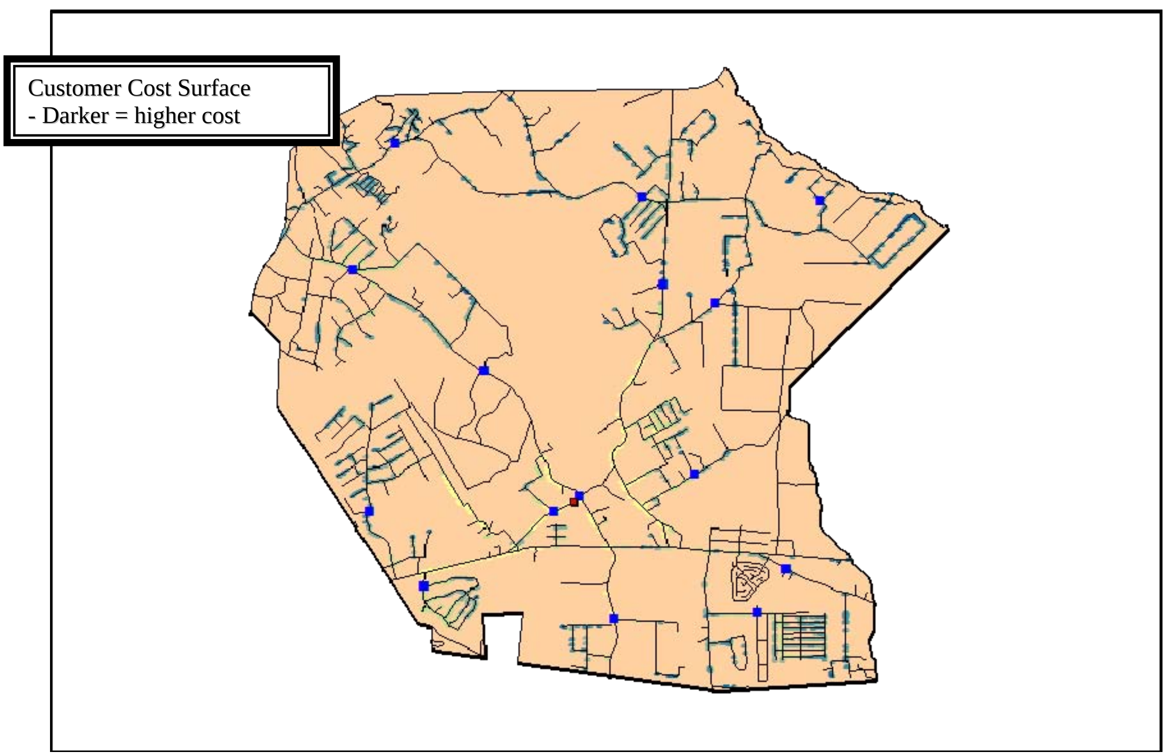


Figure 13

Figure 13 illustrates cost variations at the customer level. Each dot represents a customer with the darker color indicating higher cost.

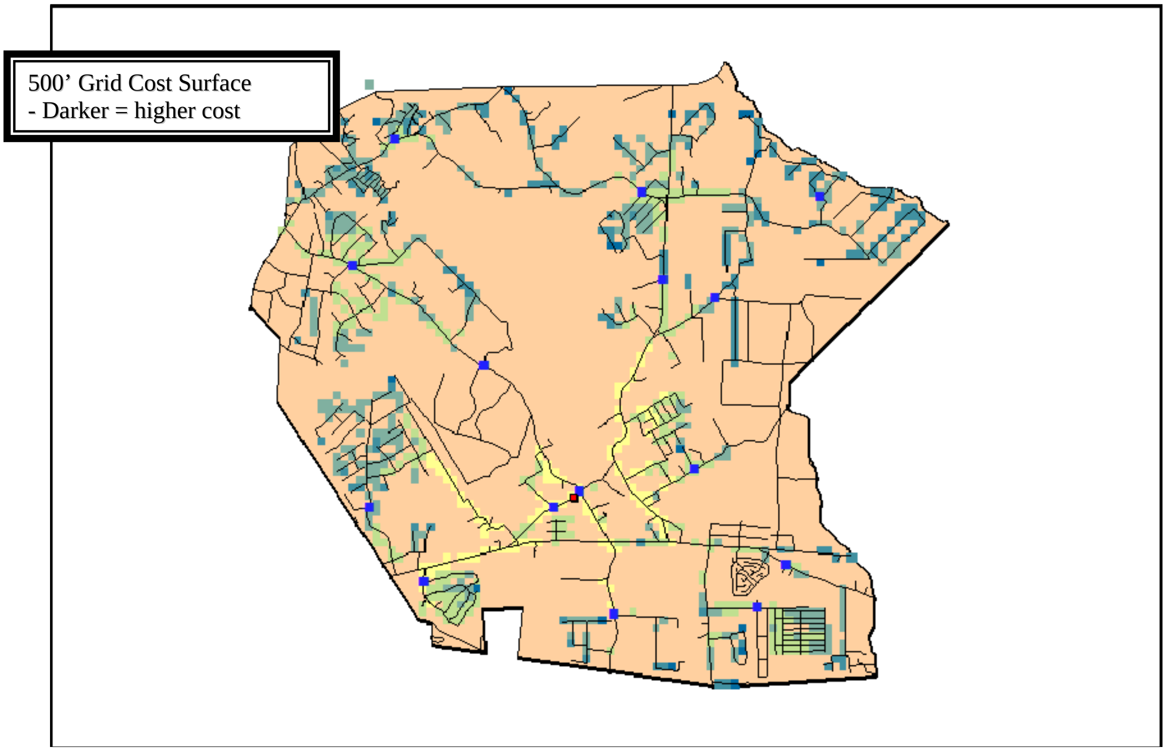


Figure 14

Finally, Figure 14 shows cost variations using 500 foot grid cells. The key take away is that with the granularity of the model, any geographic grouping is possible.

Recent Successes in Wireless Modeling and Broadband Modeling

Ubiquitous Mobility Modeling – 3G Deployment Costs

CostQuest Associates was commissioned by CTIA – The Wireless Association® - to study wireless coverage in the United States and to a) identify areas and population not served by 3G mobile broadband technologies, and b) estimate the up-front deployment costs to build a 3G wireless network to unserved and underserved areas.

To conduct the study, CostQuest collected coverage and tower locations. It then compared data to the road network where people live and commute. Partitioning up the country into cell site size lots, CostQuest was able to estimate the assets that would need to be deployed to achieve ubiquity.

CostQuest was not asked to estimate the substantial costs related to maintaining 3G networks or providing mobile wireless voice, data, and, increasingly, video services on an on-going basis. Such operations and maintenance costs must be accounted for by carriers when they determine whether an area can be economically served on an ongoing basis.

This initial study is not an attempt at creating the actual final cost, the precise tower count or the bill of materials. Rather, the authors view this initial study as the first of many steps in accurately identifying locations investments and operating costs related to ubiquitous wireless broadband coverage. Policy makers, consumers, and carriers will determine, over time, the detailed input criteria for the development of the final costs and the resulting use of the values developed. Significantly, this study also does not include the cost of spectrum.

Methodology Fundamentals

As the purpose of this study was to understand the investment necessary to deploy ubiquitous wireless broadband services, several dimensions of data were necessary for every location within the United States. The section which follows will briefly discuss how these data were generated.

To study the cost of ubiquitous wireless broadband deployment, two fundamental methodological definitions had to be addressed:

1. The goal of "ubiquitous 3G broadband service" had to be defined. For the purpose of this analysis, ubiquitous broadband was defined in terms of the ability to receive both predominant types of 3G service at all studied locations. In other words, ubiquitous broadband service means the ability to receive 3G wireless broadband service in the technology evolution from both CDMA and GSM. If an area can now only receive one class of broadband technology, it was categorized as underserved and the network was augmented from existing infrastructure to allow the support of both technologies. If the area had neither 3G technology service, the area was categorized as unserved by 3G and the network was augmented with both technologies (and possibly a tower) to support the defined level of service.

2. The geographic scope of coverage had to be defined. In the case of a wireless network this is a particularly complicated question. Because mobility is a fundamental characteristic of wireless coverage we felt it was important to both identify where population resides as well as how that population could move (e.g., roads). In other words, some combination of populated areas and paths for movement were necessary coverage targets for the ubiquitous wireless networks. We felt that road paths would capture both attributes: populated areas and paths for movement. As such, our target for coverage is road paths[33].

[33] The reader is cautioned to not infer that this coverage guarantees a specific quality of service. In other words, there is no guarantee of uniform in building or in car standard with this definition. The mobile wireless coverage used in this study does not assume that signal propagation is spread perfectly or even uniformly throughout the covered area. That is, the networks in the covered areas are continually optimized and improved for capacity growth by the carriers who own and manage them.

Methodology Steps

Once ubiquity was defined and the geographic scope of coverage was established, a number of processes needed to be developed in order to estimate investment. Ultimately, six technical steps ranging from geospatial to cost analysis were used:

1. Coverage Data Analysis - Data regarding current wireless deployment was identified, filtered and combined with other data sources. Along with the coverage pattern, the technology providing service was evaluated.

2. Technology Isolation - Those areas served by each of the wireless technologies were isolated.

3. Asset Data Analysis - Existing wireless assets (tower locations) were filtered and categorized in terms of the existing broadband coverage patterns and network protocols. These towers were then overlaid with the wireless coverage areas.

4. Road and Population Analysis - Using the coverage and asset information, the basic requirements for a ubiquitous network could then be estimated using road paths as the coverage target for network build out and estimated coverage areas as the unit of analysis.

5. Coverage Analysis - The entire U.S. was divided into areas approximating the area that could be served by a single tower in lower density areas. These cells were superimposed over the coverage and asset data. Those cells without any roads were dropped from any further analysis since there was no need for coverage. It was assumed that a new tower was needed in each of the remaining cells (those without any coverage), providing an estimated count of new tower sites that will be needed to fill out service coverage. In those cells with coverage from only one 3G technology (or only with voice coverage), the assumption was made that the existing towers within the grid cell would require augmentation.

6. Investment Development - Given the count of new sties and the count of towers requiring augmentation, both from the previous step, the investment required to deploy the wireless assets was developed.

Coverage Data Analysis

Coverage Basis Determination

In order to identify uncovered or unserved areas within the U.S., the study first identified the areas currently *covered* by a mobile wireless signal.

As a result of the complexities inherent in carrier coverage maps and in obtaining standard maps from each carrier, we elected to use a commercial coverage database which has been introduced in several regulatory proceedings[34]. For this study, American Roamer[35] provided coverage data for the top 5 wireless carriers by subscribership and 5 of the largest regional carriers[36]. The carriers included in this study represent over 97% of the wireless market share[37] and cover all 50 states, and the District of Columbia. Coverage for 3G services was derived from American Roamer's Coverage Right Advanced Services (2/2008)[38]. The geographic extent of non-3G coverage was based upon American Roamer's *Coverage Right (9/2007)* data product.

Technology Isolation

Coverage Protocol and Generation Scenarios

Given that both CDMA and GSM technologies are prevalent in the U.S. today and that the two platforms are not interoperable, coverage by the 3G evolution platforms for both types of networks will be necessary in order for all consumers to retain coverage in all areas.[39] Figure 1 below shows the generational technology protocols and research standards used for the two technologies.

[34] See uses including http://www.psc.state.fl.us/utilities/telecomm/ETCWorkshop/Alltel.pdf - Showing multiple carrier coverage in Montana and South Dakota, see also Re: In the matter of the Federal-State Joint Board on Long-Term High-Cost Universal Service Reform, WC Docket 05-337, and CC Docket 96-45 (http://fjallfoss.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6519534113)

[35] http://www.americanroamer.com/ - 5909 Shelby Oaks Drive, Suite 105 – Memphis, TN 38134

[36] Due to time and data acquisition constraints, coverage areas of smaller regional carriers were not included in the study. However, the coverage from these small regional carriers should not materially impact the results of the study.

[37] Market share was determined by using CTIA's estimate of total subscribership in the US, and applying market share numbers by carrier from Forrester Research (AT&T - 27.1%, Verizon – 26.3%, Sprint Nextel – 23.6%, T-Mobile – 11.1%). Alltel, Dobson, RCC, US Cellular, Alaska DigiTel, and Centennial Communications represent roughly a combined 9% market share. For purposes of completeness, we included in this analysis ACS's EvDO coverage in the State of Alaska.

[38] Coverage for ACS was digitized based upon marketing material available at http://www.acsalaska.com/NR/rdonlyres/64686B8E-9B6D-48B0-A365-CCF9E954EC4D/0/2007MobileBroadbandMaps.pdf

[39] This study utilizes current FCC broadband definitions.

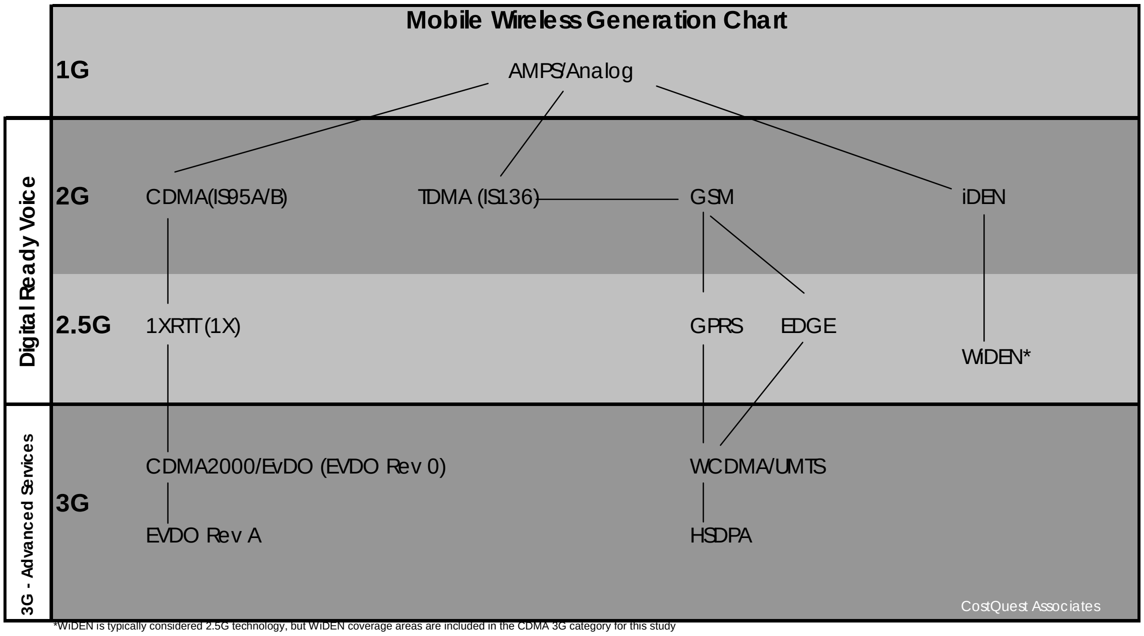


Figure 15—Mobile Wireless Technology Generation

Nationwide Build Out to 3G

As noted above, the study estimates the cost of building out the two predominant 3G evolution platforms to cover each eligible road segment in the US. In Figure 2 below, an example is provided showing the overlay of coverage on roads. Although not shown on this figure, 3G was further classed into areas with dual network providers or only a single provider.

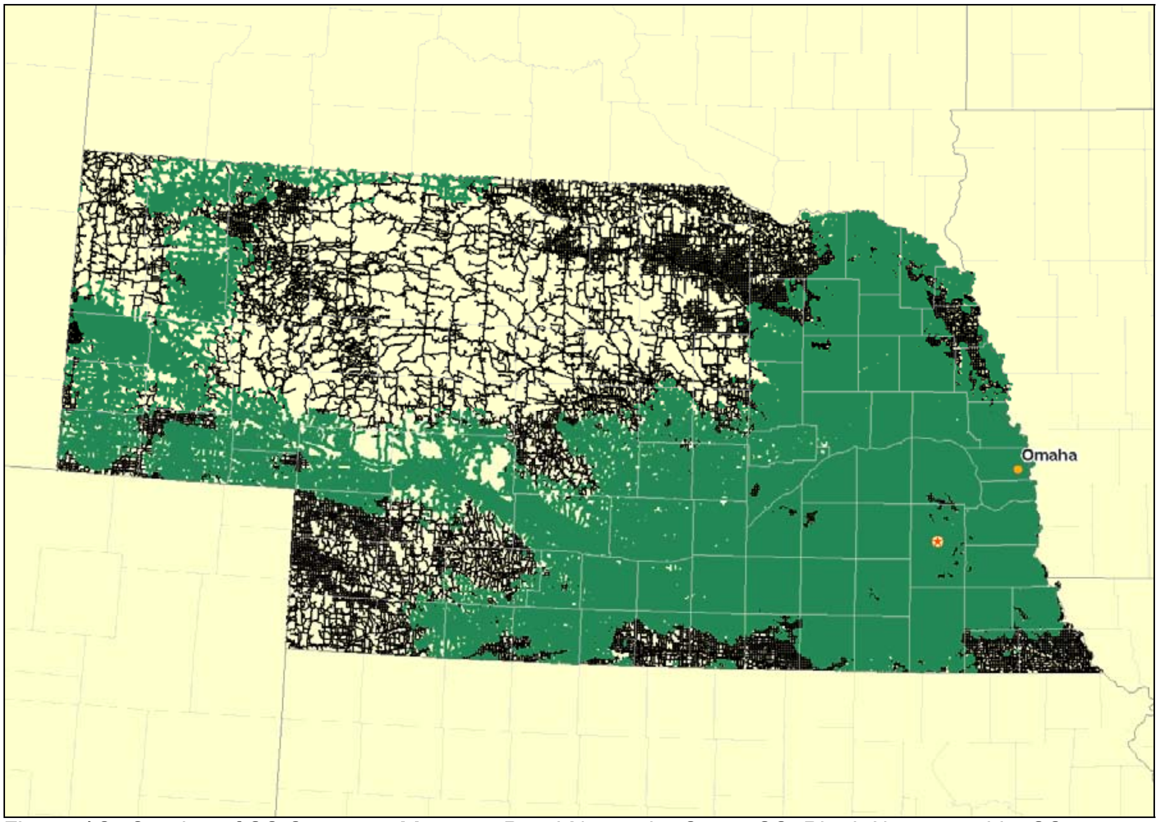


Figure 16—Overlay of 3G Coverage Maps on Road Network - Green-3G, Black-Uncovered by 3G

For those areas only receiving voice services, the study augments each cell with appropriate investment to provide ubiquitous 3G coverage. For those areas currently with no wireless service, the study augments each serving area with appropriate investment to build towers, antennas and backhaul to provide ubiquitous 3G coverage. Finally, in those areas where only one 3G technology is deployed, the study augments these serving areas with the appropriate investment to provide both 3G technologies.

Asset Data Analysis

Towers and Sites

For cells within 3G served areas, existing tower sites were used as the augmentation target. In these underserved areas it was reasoned that existing tower location information provides a better indicator of serving area engineering than does the 6mi tower radius. [40] Tower location information was obtained from Towersource.com[41]. Broadcast towers were removed from the data as well as duplicates and records outside of the area under study.

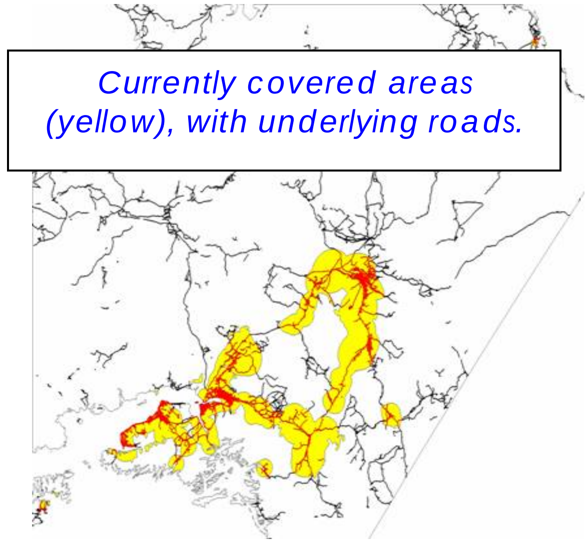
[40] In some extremely high density cells, the number of towers considered for augmentations was capped at 16, since the tower records may capture repeaters. This cap of 16 provides a cell radius of ~0.8miles with roughly a 4 mi sub grid cell coverage area.

[41] Extracted April 2008.

Road and Population Analysis
Coverage Demand Identification

Population
While not a direct unit of analysis for the development of augmentation costs, population was studied to determine the counts of potential subscribers who are in 3G unserved areas. Population data were derived from US Census 2000, SF1 population counts at the census block level. The population was then proportionally adjusted to the July 2006 county estimates. Population was allocated based upon the amount of livable road side[42] feet in that census block within each covered service territory.

Roads
TIGER 2006 First Edition roads were used as targets for where the population lives and routes for mobility. Roads were also used to allocate the census population data into the appropriate grid cells. Eligible road types were determined based upon the Census Feature Classification Code (CFCC). Vehicular trails, forest service roads, Ferry Crossings and other special paths and trails were excluded from the study[43].



To allocate population a subset of the eligible road segments were used to establish where people likely live. In other words, certain road classes such as limited access interstate highways were included in the coverage analysis portion of this study, but were excluded from calculations which allocated population within a census block.

Identifying Features of Interest
For this study isolating the population, roads, existing tower assets and extent of coverage by technology was necessary. This was accomplished by using a Geographic Information System (GIS)[44].

A geoprocessing model was used to identify road segments which were not covered by a 3G technology. The geoprocessing model effectively analyzed each eligible road segment and recorded the amount of that segment intersecting each 3G covered area.

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[42] As a road may represent a different census block on its left side and right side, the side feet of roads were used as the population allocators—not the centerline distance.
[43] If any of these additional roads and trails were included in the analysis, there would be considerably more road miles to cover.
[44] ESRI, ArcView, 9.2 Build 1420

Using the geoprocessing model, five classes of eligible roads were developed. The first class was all possible eligible road segments. The second segment class included roads covered by only voice technology. The third class was road segments covered by both a CDMA (EvDO) and GSM (HSDPA) class of 3G broadband service. The fourth class was a segment covered by only GSM (HSDPA) based 3G. The fifth class was a segment covered only by CDMA (EvDO) based 3G.

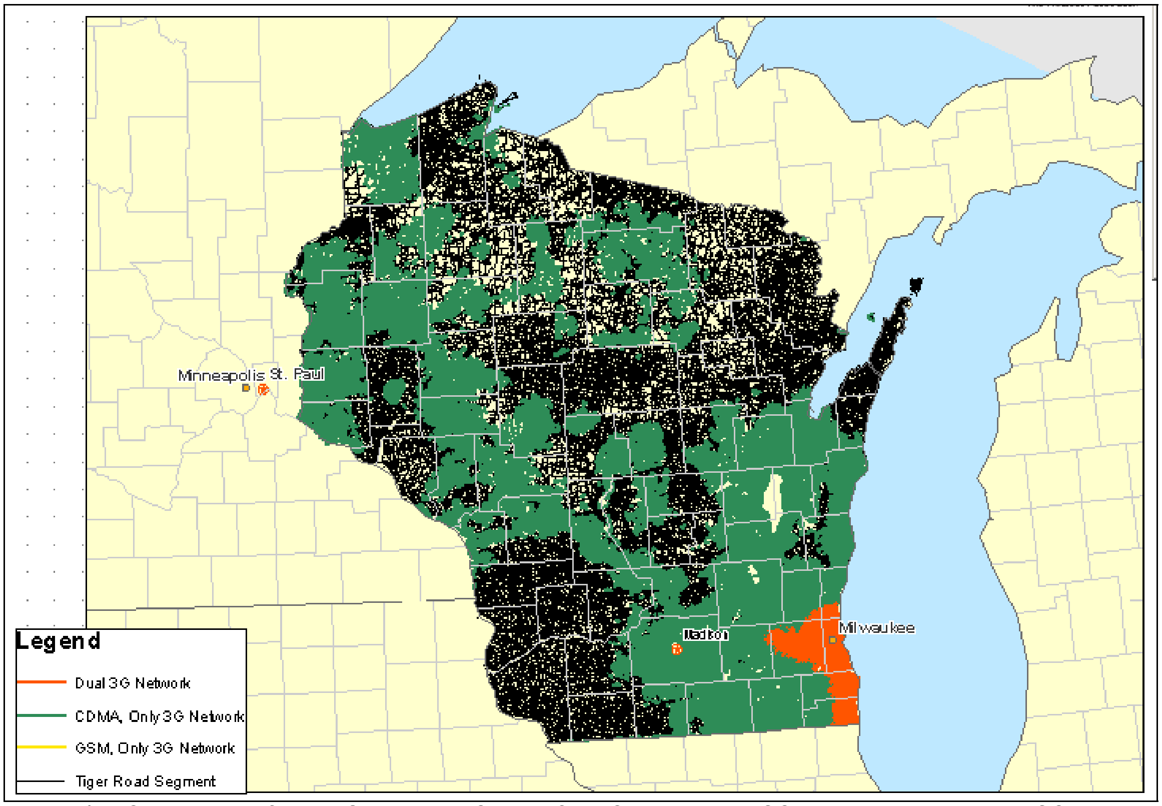

Figure 17--Categories of Road Segments: Green- Only CDMA based 3G, Black-Uncovered by 3G, Red-Covered by both a GSM and CDMA based 3G network.

Coverage Analysis

Cells and Coverage

As described in the Assumptions and Calculations discussion at the end of this section, a 6 mile serving radius was used to represent the reach of a tower site in lower density areas[45]. This 6 mile serving radius equated to a 8.48 x 8.48 grid cell[46]. Once the road segments were classed by the served network technology, they were then classed within each cell[47].

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[45] We assumed that in lower density areas, distance from the tower was the key limitation on design. As density increases (i.e., users), both traffic and distance can limit the service area of a tower.
[46] This size cell was used as it is the smallest square which can bound a 6mi radius tower serving area.
[47] There we approximately 50,000 grid cells in the study covering more than 39 million road segments.

The amount of road centerline feet covered by each network protocol within a grid cell was then used to determine whether 3G augmentation would be required[48] and the type of augmentation. Grid cells with no road feet covered by an existing 3G or voice technology required a full site deployment (e.g., tower, antenna, backhaul, etc.). In these areas, a single site was assumed sufficient to serve the entire cell.

Grid cells covered by only voice based technologies (i.e., no current 3G deployment) were identified as areas that required upgrades to both 3G technologies. In contrast to the unserved areas, these grid cells only required upgrade equipment – augmentation - rather than the equipment needed to fit out a full tower site. In these areas, it was also assumed that a single tower site could be deployed with 3G equipment to serve the entire area.

The final types of areas analyzed were those that were partially covered with 3G services.[49] In those grid cells where both technologies were deployed, no investment was necessary. However, in those grids with only one 3G technology, the underserved area was augmented so that existing tower sites within that area were augmented to make both 3G technologies available. Unlike the unserved 3G areas, we augmented a percentage of the actual tower count within the grid cell[50], since the actual tower count provided the actual cell sizing criteria in higher density areas – rather than our estimated 6 mile based grid cell.

Investment Development

As mentioned in the introduction, this study was commissioned to identify only the initial capital investment of deploying ubiquitous wireless broadband coverage across the nation. As such, these estimates are not comparable to other Universal Service cost estimates, since such mechanisms represent the average monthly or annual costs of providing service, including capital costs and operations and maintenance costs. This study also did not attempt to include the costs of spectrum, which are often significant.

Direct and Indirect Capital Investment Estimates

For those areas already served by both a CDMA (EvDO) and GSM (HSDPA) based 3G technologies, no additional investment was needed. By-in-large, fully deployed 3G areas reside in counties with population density greater than 100 people per square mile. To put that into perspective, the FCC has reported that 79% of the U.S. population lives in non-rural counties representing no more than 14% of the geographic area of the United States.[51]

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[48] For purposes of the study, augmentation was triggered when more than ½ mile of roads within a grid cell was found to be uncovered.

[49] As a conservative approach, a cell partially covered by a 3G technology was considered fully served by the specific 3G technology.

[50] For purposes of the study, we assumed that 40% of the towers (minimum of 1) within a 3G grid would need to be augmented to provide service for the currently non-deployed 3G technology. The 40% was derived from an assumption that ½ of the towers were required for each technology. We reduced our ½ assumption to account for concerns that the tower data may contain non-tower sites such as repeaters.

[51] See Annual Report and Analysis on the Competitive Market Conditions With Respect to Commercial Mobile Services, WT Docket No. 07-71, FCC 08-28 (rel. Feb. 4, 2008), at para 37.

For those areas that are currently unserved by any wireless service, the grid cell analysis provided the total counts of tower sites that need to be deployed. This count of tower sites was multiplied by the costs for a full site deployment for both technologies. This full site deployment cost includes the base station, tower, antenna, site acquisition, microwave backhaul, etc.

For those areas where a tower exists but service coverage has to be augmented to provide full 3G level service, the grid cell analysis provides the count of towers where the technologies need to be deployed. Based on the deployment requirements, the tower count was then multiplied by the required augmentation costs, which include all upgrade components required at the site.

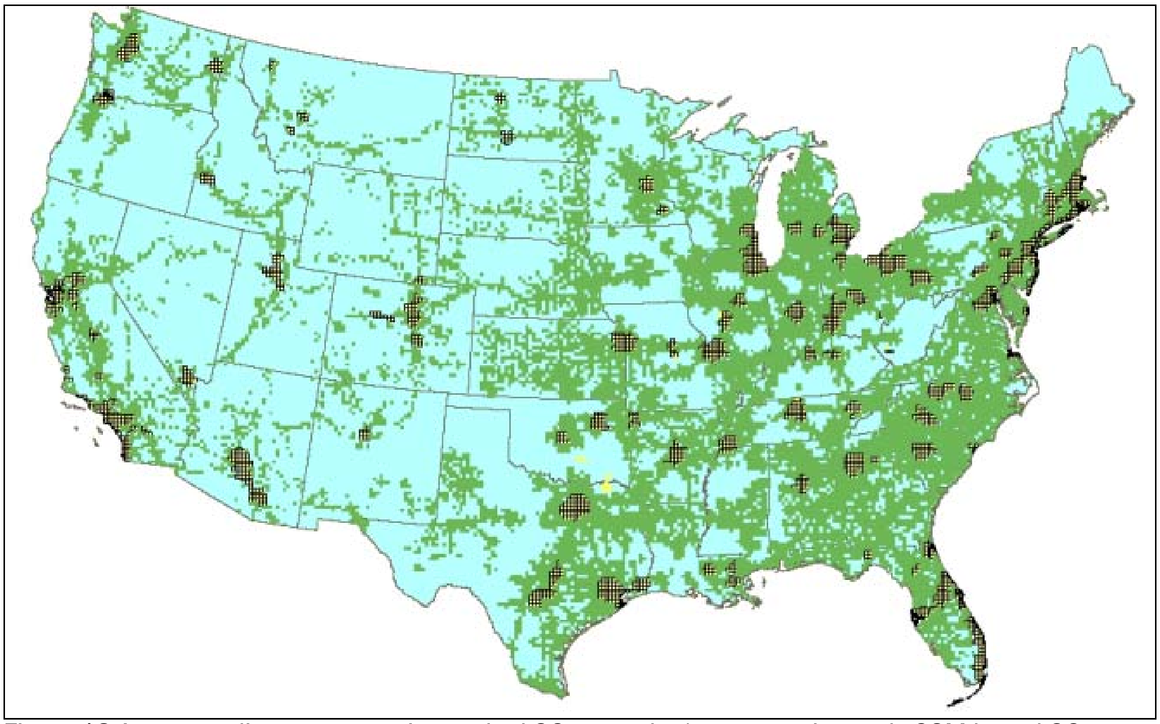

Figure 18-Areas needing augmentation to dual 3G networks (green requires only GSM based 3G, yellow requires only CDMA based 3G)

Costs used in the study were based on input from 4 wireless carriers. The cost inputs reflect the various buying power of providers, ranging in size from national carriers to smaller regional carriers.

Estimates on secondary capital were also included in the study by multiplying the tower and augmentation costs by a factor. These secondary investments include switching, motor vehicles, furniture, tools, etc. The factor applied only represents the secondary capital investment related to the initial build-out for unserved and underserved areas.

Spectrum costs were not included in this study. The substantial costs associated with acquiring spectrum should be considered for further studies.

Wyoming Broadband Model: A case study in Success

Has the data, approach, granularity, and multiple technology deployment described in the prior section been used in concert? - Unequivocally, yes in our recent Wyoming Broadband study. This project highlights the ability to use geographic information systems (GIS) to showcase and understand critical issues, the ability to model multiple technologies, and the value of these models to provide valuable information to policy makers.

The goals of the Wyoming study were to a) Identify Broadband Gap Areas, and b) determine the cost to deploy in a Broadband Gap Areas via multiple Technologies. Study findings were displayed with GIS visualization. Though other states have conducted broadband gap studies, none have included the costs components to the extent included in the Wyoming Broadband Model. This allows carriers and policy makers to use investment information to consider and promote broadband deployment via all available technologies.

The following provides a summary of the results from the study[52].

[52] . If the reader is interested in greater detail, they can review the study's whitepaper "Cost and Benefits of Universal Broadband Access in Wyoming" available at http://www.costquest.com/costquest/docs/CostsAndBenefitsofUniversalBroadbandAccessInWyoming.pdf

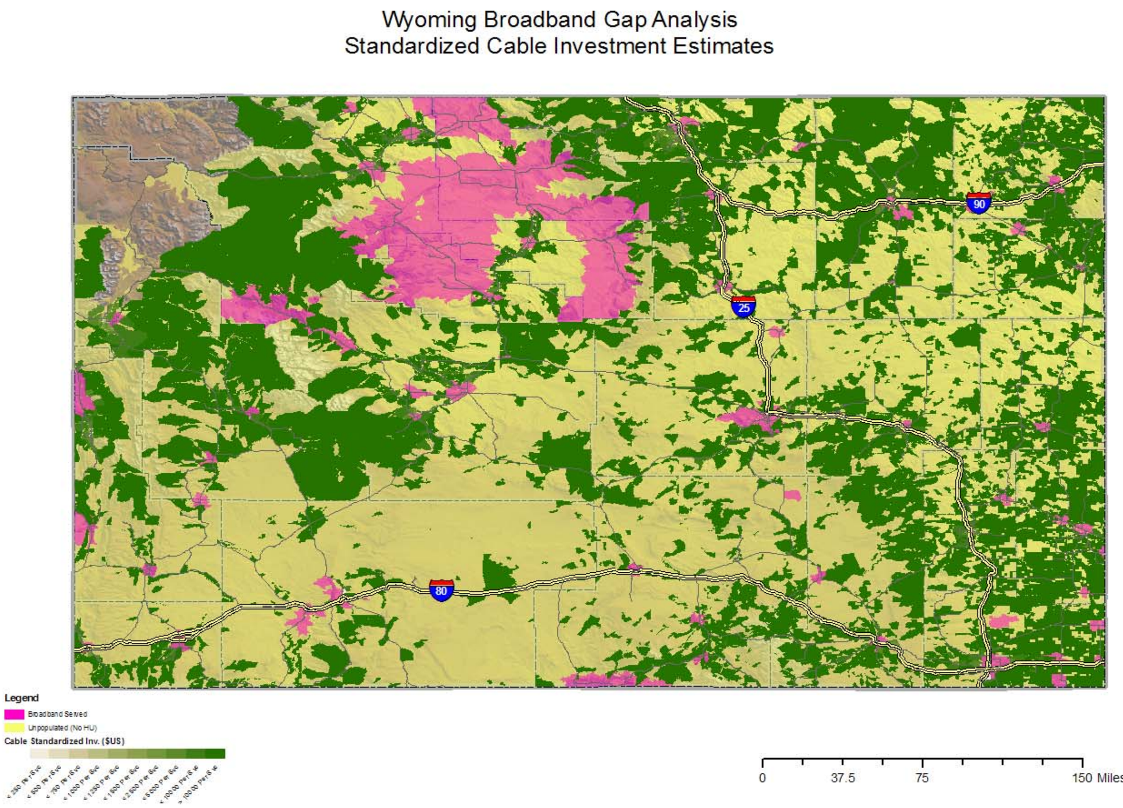

Figure 19

In Figure 19, pink is broadband enabled portions of the state, yellow is unpopulated, and the gradations of green represent the cost of deploying cable on a per customer basis. There are several items of note. First, 80% of Wyoming households have access to broadband and are located in the pink areas. Second, a good proportion of the state is unpopulated. And third, while most of the cable areas are dark green (high cost) this does not imply that Cable is a high cost service. Rather, due to the fact that the existing cable networks are already broadband enabled and only cover a small footprint, the cost to expand the broadband customer base reflects Greenfield deployment. That is, existing providers do not have not have existing facilities to augment in these gap areas.

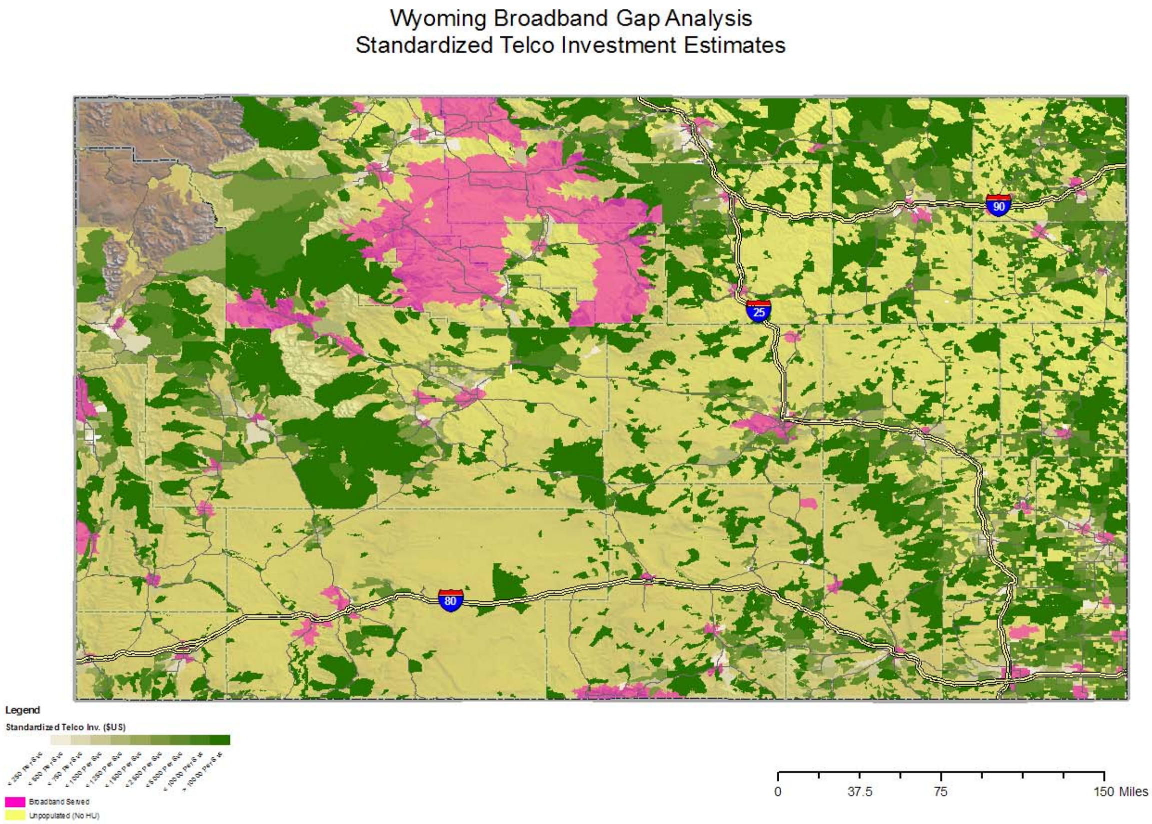

Figure 20

Now consider Telco. In Figure 20, with the same state view, the green shading now represents the telco costs (rather than cable costs). Note, there are many areas with lighter shades of green (lower cost) as compared to cable.

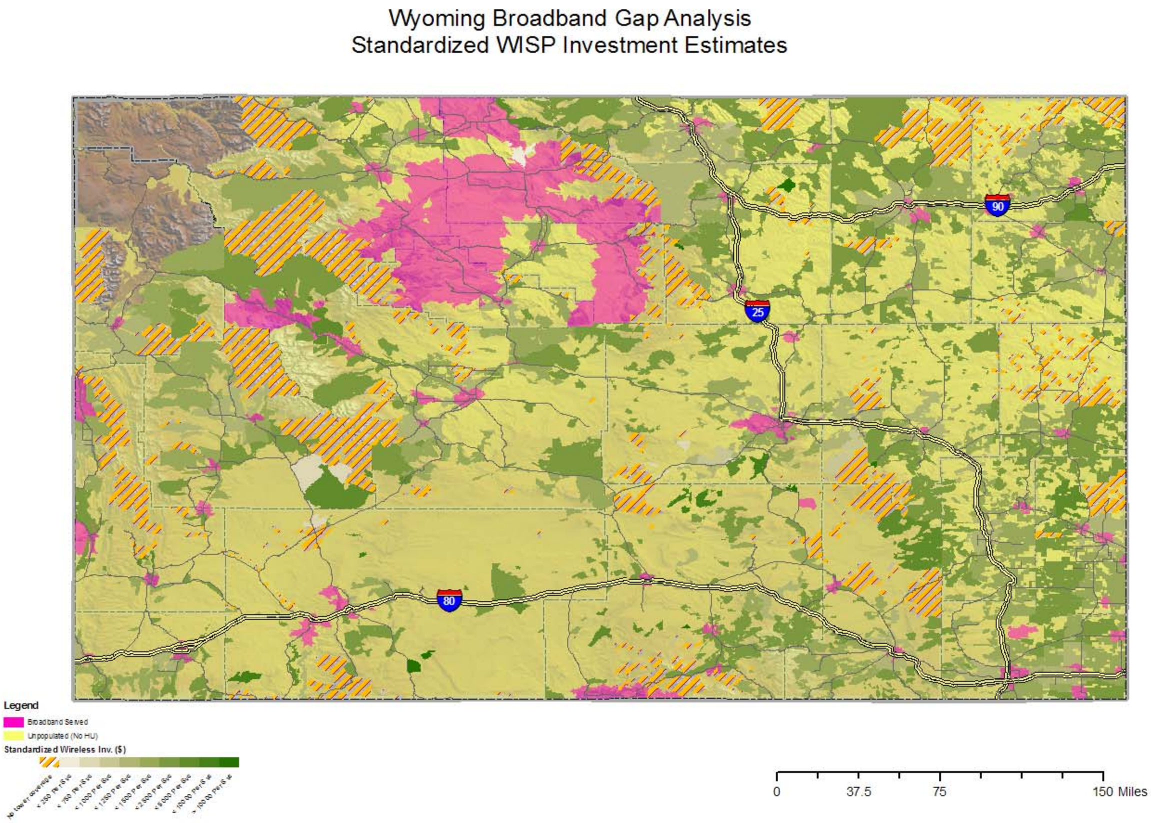

Figure 21

Finally, consider Figure 21, with the addition of orange shading which reflects areas that could not be covered with the existing towers in Wyoming. While it visually appears that fixed wireless is more efficient than Telco or Cable, the cost to augment telco is actually more cost effective for a majority of the customers (but not the majority of geographic areas) who fall into the broadband gap areas. Based on the uniform light green, it is apparent that Fixed Wireless is more efficient based on land area and that it offers economies in the less dense portions of the state.

In summary, the Wyoming Broadband Model exhibits many of the core features we recommend for a new USF model. These features are:

- The ability to model high-cost, low density areas;
- The ability to provide a high-level of granularity for cost components;
- The use of GIS and spatial tools to further define cost areas and to promote understanding of the model and underlying issues;
- The ability to use existing assets as well as consider Greenfield deployments;
- The ability to model and compare the costs of multiple technologies; and,
- The ability to compare technology costs at a Census Block level.

As a result of this study, it is apparent that full access and disclosure of the data and maps for this project has lead to greater input and contribution from carriers and has ultimately brought about a more accurate model. Given the accuracy and usefulness of this model, Telecommunications providers and policy makers alike have accepted and even promoted it as the key tool for use in closing the technology gaps in Wyoming.

CETC Costing: 2006 Wireless CETC Cost Development Case Study

The goal of the **2006 Wireless CETC Cost Development Case Study** was to develop universal service costs per subscriber for a wireless CETC within the ILEC service areas they provide service. The universal service costs of the wireless CETC were developed in order to mirror, in part, the development of universal service costs for landline ETCs. The basic formula was [Direct capital costs + Indirect capital costs + Spectrum costs + Operational costs + Corporate overhead]. Two rural states were chosen for this study. The following provides a brief overview of the development of each component in the cost study:

- **Direct Capital Investment –** This step identified the direct capital investments associated with the CETC customers.
    - In order to capture the impact of a variety of operating areas in which a CETC operates, these costs were developed on a tower by tower basis. All customers served by a particular tower (the relationship between a tower and a customer was defined by the tower coverage area in which the customer's billing address was located) were assigned the same costs (tower costs divided by the count of customers). Excluded from this study was any direct investment made to exclusively support roaming agreements and roaming customers. The allocated portions of shared and indirect assets were based upon the usage ratios between installed base and roaming traffic.
- **Indirect Capital Investment –** This step identified the indirect capital costs (including switching) associated with CETC customers and loaded these into the cost of universal service.
    - As a first step, the indirect capital investments were converted into a cost using the appropriate monthly charge factors. Using a ratio of total indirect capital costs to total direct capital investments, these indirect costs were then apportioned to each tower.
- **Spectrum Costs –** The development of the per customer spectrum costs.
    - The current value of the spectrum licenses was divided by the total customer counts within each state. This per customer capital value was then converted to a monthly cost.
- **Operational Costs -** The development of the operational costs associated with universal service.
    - Using booked expenses (excluding depreciation) of the CETC, the per customer operational costs were developed. Each expense category was analyzed to determine if it was an appropriate expense and what portion was assigned to universal service. In most cases, the ratio of local revenue

    - to total revenue was used to determine the portion of expense applicable to universal service.
- **Corporate Costs –** This step identified the per customer corporate expenses.
    - Corporate costs of the CETC studied were allocated to each state (e.g., centralized customer support, etc.). Similar to the operational costs, only a portion (using the ratio of local revenues to total revenues) of the overhead was assigned to universal service.

Once the various cost components were determined and allocated, the costs were converted to monthly numbers and associated with the appropriate subscriber base. The following provides a brief overview of the development of cost conversion and customer attribution:

- **Conversion to Monthly Costs** - Converted the various investments and expenses to a monthly cost.
    - In order to derive the monthly costs of a wireless CETC's universal service, the investments were converted to cost through the application of monthly charge factors. These factors capture the cost of money (including both cost of equity and cost of debt), income taxes, property taxes, and depreciation.
        - The monthly charge factors were derived based upon CostQuest's CQCapCost model. This model follows typical FCC approved approaches. Inputs into the model captured basic defaults used in wire line studies (e.g., similar gompertz-makem curves, 11.25% used as the cost of money, etc.). For depreciation lives, conservative values based upon the CETC's experience were used.

- **GIS Approach/Customer Attribution** - In order to determine per line costs, a process for locating installed subscribers was developed.
    - To determine the count of customers within each tower's service area, each customer record was geocoded and analyzed. The geocoded location of the customer's billing address was used and compared to the service area of the towers.
    - The geocoded location was also used to determine the ILEC service area.
    - Once the cost of customers on a tower were determined, the customers within an ILEC service area were rolled up to develop the weighted average (line costs weighted by line counts) costs for the CETC within the ILEC's service area.

Results of the Study

The results show that the CETC's wireless costs are comparable, on a consolidated basis, to that of the incumbent provider's costs in these states. Results vary across study areas and wirecenters. In the study areas where the ILEC loops are very few, ILEC costs per subscriber tend to be higher. The chart below shows the cost comparison between the CETC and ILECs for the two states studied.

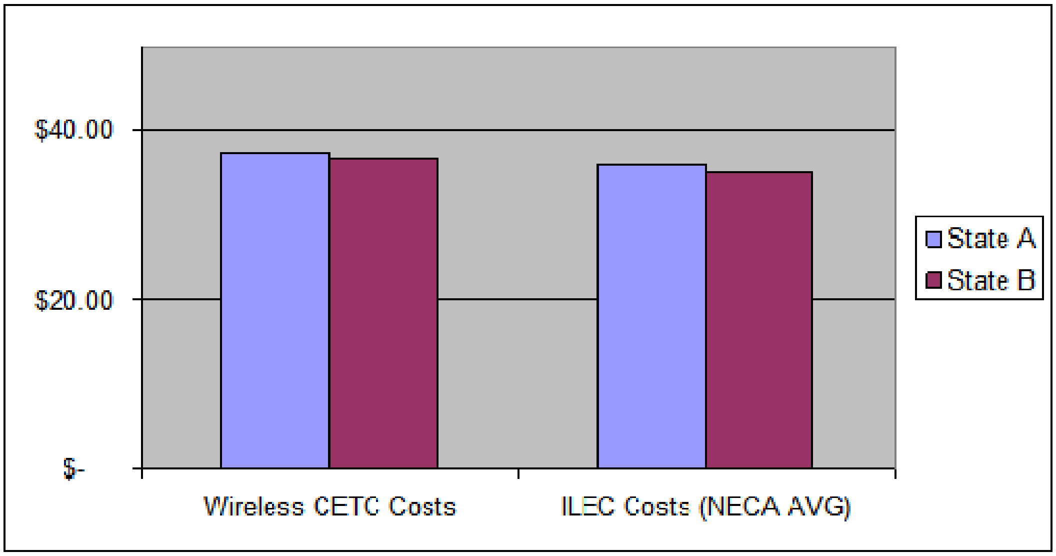

Figure 22

The Modeling Path Forward

We understand that parties may have had issues with the cost models of the past. There have been issues and concerns expressed regarding transparency and verifiability of some cost models, as well as issues on the technology side. We hope that the material presented here demonstrates that today's cost models offer significant advancements in methodology, data, technology, accuracy, and application. In fact, these models are being used today for more than just universal service. They are used to set UNE, interconnection, and retail prices, and in some instances they are used to provide information on technology deployment, for property tax and merger valuations, and profitability analyses. Today's cost model are now an integral part of the telecommunications landscape.

Consider the critical questions: What models are available to consider for this proceeding? What models are currently being built? What will policy makers have available to them as they set up the new universal service system?

We propose the development of a modern cost model. CostQuest (and others are invited to join the coalition) is committed to creating the cost model that can be used in today's universal service debate. In the following section, we describe the key design criteria for the model, the technologies to be modeled, the geographic parameters, the inputs required, and some of the policy questions that will need to be answered.

The goal in any modeling exercise is to obtain the most accurate cost outputs possible, given a set of problem statements, business requirements, regulatory guidelines, data and technological constraints.

However, the approach employed for the updated universal service solution should not be unknowingly constrained by the modeling approach selected. CostQuest offers to act as a guide in the identification of potential approaches, and evaluation of constraints and tradeoffs so that parties to this proceeding can make informed decisions as to how best to move forward.

Historically, there have been a number of network modeling approaches used. Each approach was developed at a particular point in time, generally to answer a specific regulatory question (or in some instances a business question). However, past approaches are not necessarily well suited to deal with current USF issues. While past approaches may have been reasonable at the time, they may have been eclipsed in accuracy and robustness by subsequent approaches.

For example, the latest generation of wireline network modeling approaches represents substantial improvement upon the initial proxy models (e.g., HCPM, BCPM) by implementing more advanced plant placement and routing algorithms and by utilizing more actual data (customer, services, services requirements, roads, and plant data) when and where it exists. In addition, these next generation approaches are auditable, transparent, and generally robust in that the majority of network engineering drivers (such as customers served from a DLC or copper gauge crossover) are now user adjustable inputs that can be easily manipulated to meet the specific criteria of the cost study.

To speed up the implementation effort, CostQuest will base the solution on our latest generation of modeling platform, CostPro, which can be populated with a geocoded customer data set. This will allow parties to use as much actual data as possible with the latest and most advanced algorithmic approaches.

Toward the path

Below we present a set of key questions to be answered in order to best move forward (preferably with some degree of consensus) to construct the solution. We understand that parties may not have answers to all these questions. Therefore, we have made recommendations to start the process (recommendations, questions, issues, and/or data choices are in script).

Without answers to many of these design questions and without knowledge of the full scope and format of potential data that will be relied upon, it is difficult to describe a defined and specific project. However, that does not mean that there is not a path forward that can account for these unknowns. On the contrary, it is our experience that these uncertainties are the norm. Creating a universal service platform is a large undertaking and it is unreasonable to believe that all issues will be known and settled on day one. Therefore, the approach chosen must be flexible in recognition of these unknowns.

4. What are the design criteria?
    a. What technologies are we modeling?
        - *Model LEC landline and wireless (can be fixed or mobile) separately, to provide robust reporting data for advocacy efforts.*

- *Incorporate, at a minimum, a Fiber to the Node (FTTn) approach for LEC Landline.*
- *Depending on the type of wireless:*
    - *For Mobile wireless, incorporate either GSM or CDMA*
    - *For Fixed wireless, incorporate Motorola Canopy (or similar) system*

b. What is the cost object, that is, what does universal service entail: Is it a broadband pipe or a narrowband link, do we need to capture switching/signaling-SIP/IP Network, what features are included?

- *Modeling should capture concept of an "access pipe" to customers*
    - *This concept implies the* ***ability*** *to deliver a broadband pipe to customers*
        - *The need to define minimum size of pipe*
    - *No need to look into costs that are not geographically driven (switching, peering, signaling/SIP)*

c. What are the regulatory criteria: What are the carrier of last resort requirements, minimum service standards, intercarrier compensation, etc.?

- *The implemented model should follow the current principles as laid out by the FCC, irrespective of the geographic area classification (rural, non-rural). This includes:*
    - *Scorched node*
    - *Forward looking*
    - *Efficient provider*

d. What are the economic criteria: What is the take rate, what is the level of scorched node, what defines TELRIC, is it forward looking and, if so, how forward looking, etc.?

- *Use current FCC rules for TELRIC and scorched node (use known towers and CO locations)*
- *Use available and deployed technologies*
- *We will need to develop take rate approach and values.*

e. What are the modeling criteria?

- *Implement updated forward looking, actual cost model for ALL landline and wireless carriers based on next generation modeling approaches, in part to address any issues rural carriers may have had*
    - *Use Minimum Spanning Road Tree ("MSRT") for creation of the landline clusters, and the routing of the distribution, feeder, and transport network to design an efficient, optimal landline network*
    - *Use MSRT to create the backhaul network for the wireless towers*
    - *Cluster customers to towers based upon RF Propogation and/or viewshed analysis.*
- *Modeling inputs (e.g., prices, labor rates) should account for the unique attributes of the service area.*

   - *Recognize rural and non-rural operational costs, engineering approaches, material prices, and technologies to be used for both the landline and wireless networks.*

5. Input Criteria:
   a. What is the source of service demand, material, labor rate, and engineering inputs?
      - *Ideally, customer data should be updated and improved over the HCPM and represent the full population of customers in an area irrespective of their selected carrier. Additionally, the customer data should be provided at the actual geocoded[53] location of the customers.*
         - *In the short run for a proof of concept approach, we may use the existing HCPM data to minimize the proof of concept development costs.*

   b. What is the source of operational expenses to capture uniqueness of landline versus wireless?
      - *ILEC: In the short run, base it upon publicly filed data or current HCPM values.*
         - *How will rural differences be captured, or not?*
      - *Wireless: Survey providers or access public sources*

   c. What is the source and how much actual network (towers, exchange locations, boundaries) do we use?
      - *Use at least the following plant data from the best data sources.*
         - *On the landline side: wirecenter boundaries, central office location, and tandems.*
         - *On the wireless side, licensed areas, towers, tower coverage areas, tower technologies, and POPs*

6. Output Criteria:
   a. What is the geographic entity for calculation, comparing and reporting?
      - *Create output at a census based level to allow ample flexibility in comparative reporting and to allow the use of targeting in the support model.*
      - *Also provide capabilities to report out at ILEC wire center level, Service Areas, and states*

Planned Deployment Approach

As we move forward and get clarification on the path forward design criteria, the following provides a high level project plan with specific dates for delivery.

[53] Address geocoding matches a customer record (which includes the services at the address) to a location on the side of a street by address range to yield a latitude and longitude.

Proof of Concept

Scope:
In this first phase, the conceptual design document will be created that provides the specifications for algorithms, technologies, input requirements, and output requirements and a mock up of what the system will look like and what outcomes it will produce for the user.

Prototype

Scope:
This deliverable will implement the proof of concept design, utilize test input data, and present the capabilities. Specifics of the release include (recommendations, questions, issues, and/or data choices are in script):

1. What states will be modeled?
    - *This will depend on the response of parties to this proceeding. At a minimum it will look at a number of studies areas but could include up to 3-5 states. The data used should capture variability in density, terrain, and carriers.*

2. What are the sources for the input data?
    - *Customer data:*
        - *HCPM data (recommended for costs control and to allow comparisons to prior output)*
            - *Low Cost – Can compare to older results – does not get past issue parties have had with data – some of the data is 16 years old*
        - *Updated census data for residential and publicly-sourced business data*
            - *Mid-Cost – census is 8 years old*
            - *Will require new modeling to get to access lines and/or take rate in a geographic area*
        - *Public sources, company data, etc..*
            - *High Cost – similar to how HCPM was developed – will extend development timeframe*
    - *Telecommunication plant location and boundaries.*
        - *ILEC:*
            - *Use Teleatlas wirecenter boundaries*
                - *Will not match current USAC study areas*
        - *Wireless:*
            - *Request from CTIA membership in geocodable format*
                - *Mid Cost – Best Source – May have issue geocoding*
            - *Use public source*
                - *Mid Cost – issue with which towers to use for the study. May not have enough towers constructed to cover entire country.*
    - *Operating expenses (obtaining and identifying the proper operational expenses can be difficult and costly)*
        - *ILEC*

        - *Scour ARMIS and NECA data*
            - *Mid Cost – will need to dig through data – need to determine how to adjust to make forward looking – need to determine how to capture and/or incorporate rural differences*
        - *Use HCPM value of 7.32*
            - *Low Cost – does not recognize company size – is over 10 years old*
    - *Wireless:*
        - *Purchase publicly available data on cost of service for mobile carriers (may have issues using it publicly)*
            - *Low cost if CTIA is a member of the Yankee Group*
            - *Mid cost if we have to purchase as a non-member*
        - *Survey members*
            - *Mid cost – will need to analyze data, put in a consistent format and capture consistent categories*

3. What modeling approach should be used?
    - *Implement CostPro next generation code for network modeling*
        - *Review current engineering approach and technologies to be used for wireline, wireless and fixed wireless network.*
    - *Convert investments to monthly expenses with the application of annual charge factors to account for depreciation, taxes, cost of money associated with the capital investment in the plant used to provide service.*

4. What output should be produced?
    - *Produce output with CB, wirecenter, service area and state flags for roll up over various dimensions*
    - *Implement dynamic reporting tool.*
    - *Determine level of geographic area to report out, key variables of interest and what drill down capabilities are required*